Modicon M340 with Unity Pro

Analog input/output modules
User manual

07/2012

35011978.07

www.schneider-electric.com

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This manual describes the hardware and software implementation of analog modules for M340 PLCs and X80 drops.

Validity Note

This documentation is valid from Unity Pro V7.0.

Product Related Information

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter, and apply this product. Follow all local and national safety codes and standards. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Physical Implementation of Analog Modules

I

In this Part

This part is devoted to the physical implementation of the family of Modicon M340 PLC analog input and output modules, as well as of dedicated TELEFAST cabling accessories.

What Is in This Part?

This part contains the following chapters:

General Rules for the Physical Implementation of Analog Modules

1

Subject of this Chapter

This chapter presents the general rules for implementing analog input/output modules.

What Is in This Chapter?

This chapter contains the following topics:

Installing Analog Input/Output Modules

At a Glance

The analog input/output modules are powered by the rack bus. The modules may be installed and uninstalled without turning off power supply to the rack, without causing any hazards and without there being any risk of damage or disturbance to the PLC.

Fitting operations (installation, assembly and disassembly) are described below.

Installation Precautions

The analog modules may be installed in any of the positions in the rack except for the first two (marked PS and 00) which are reserved for the rack's power supply module (BMX CPS ••••) and the processor module (BMX P34 ••••) respectively. Power is supplied by the bus at the bottom of the rack (3.3 V and 24 V).

Before installing a module, you must take off the protective cap from the module connector located on the rack.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

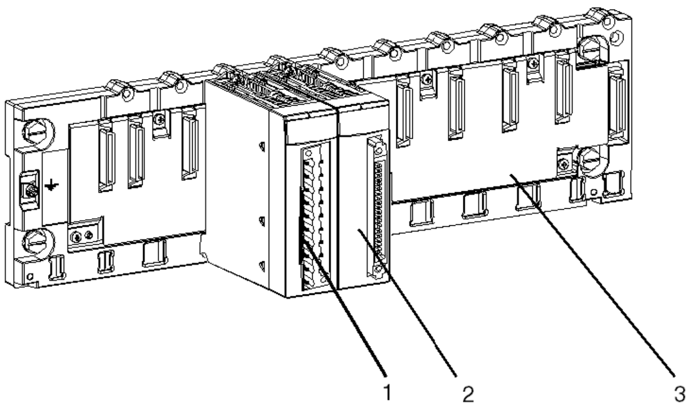
While mounting / removing the modules, make sure that the terminal block is still connected to the shield bar and disconnect the voltage of sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.

NOTE: All modules are calibrated at factory before being shipped. Generally it is not necessary to calibrate the module. However, for certain applications or because of standard requirements (e.g. in pharmaceuticals) it may be advisable or even necessary to re-calibrate the module in specified time intervals.

Installation

The diagram below shows analog input/output modules mounted on the rack.

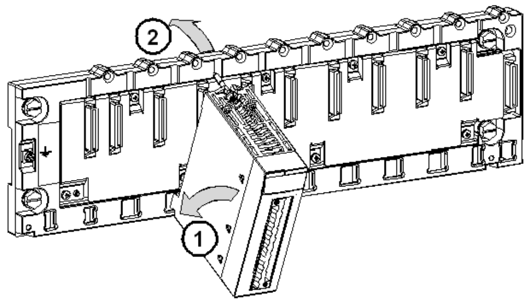
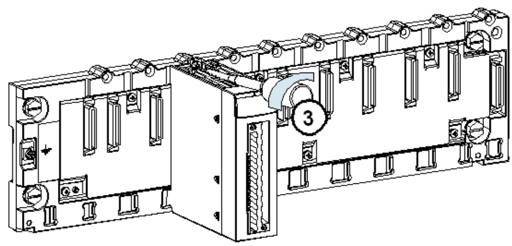


The following table describes the different elements which make up the assembly below.

Number	Description
1	20-pin terminal block module
2	40-pin connector module
3	Standard rack

Installing the Module on the Rack

The table below presents the procedure for mounting the analog input/output modules on the rack:

<table>
<tr><th>Step</th><th>Action</th><th>Illustration</th></tr>
<tr><td>1</td><td>Position the locating pins situated at the rear of the module (on the bottom part) in the corresponding slots in the rack.
Note: Before positioning the pins, make sure you have removed the protective cover (see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual).</td><td rowspan="2">Steps 1 and 2
</td></tr>
<tr><td>2</td><td>Swivel the module towards the top of the rack so that the module sits flush with the back of the rack. It is now set in position.</td></tr>
<tr><td>3</td><td>Tighten the retaining screw to ensure that the module is held in place on the rack.
Tightening torque: 1.5 N•m max. (1.11 lb-ft)</td><td>Step 3
</td></tr>
</table>

Fitting a 20-Pin Terminal Block to an Analog Module

At a Glance

The BMX AMI 0410, BMX AMO 0210, BMX AMO 0410, BMX AMO 0802 and BMX AMM 0600 modules with 20-pin terminal block connections require the latter to be connected to the module. These fitting operations (assembly and disassembly) are described below.

⚠ CAUTION

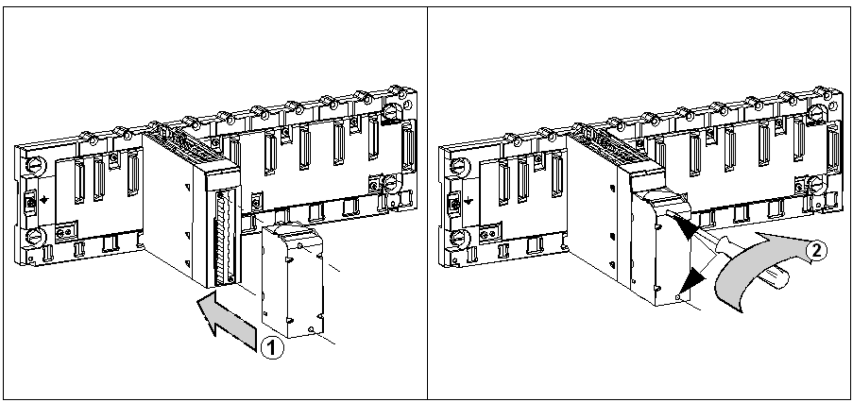
EQUIPMENT DAMAGE

Be careful not to plug an AC terminal block on a DC module. This would cause equipment damage.

Failure to follow these instructions can result in injury or equipment damage.

Installing the 20-Pin Terminal Block

The following table shows the procedure for assembling the 20-pin terminal block onto BMX AMI 0410, BMX AMO 0210, BMX AMO 0410, BMX AMO 0802 and BMX AMM 0600 analog modules:



Assembly procedure:

Step	Action
1	Once the module is in place on the rack, install the terminal block by inserting the terminal block encoder (the rear lower part of the terminal) into the module's encoder (the front lower part of the module), as shown above.
2	Fix the terminal block to the module by tightening the 2 mounting screws located on the lower and upper parts of the terminal block. Tightening torque: 0.4 N•m (0.30 lb-ft).

NOTE: If the screws are not tightened, there is a risk that the terminal block will not be properly fixed to the module.

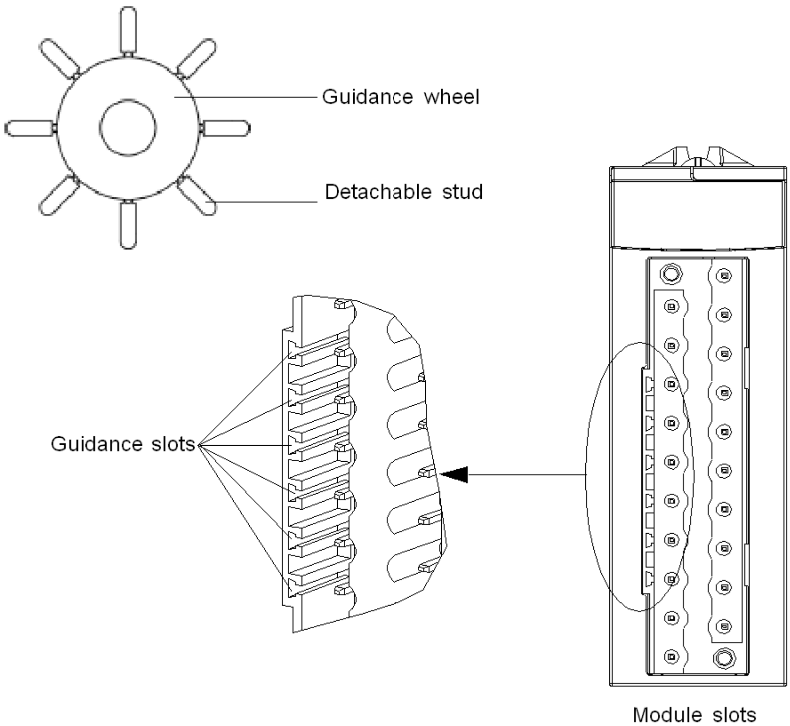
Coding the 20-Pin Terminal Block

When a 20-pin terminal block is installed on a module dedicated to this type of terminal block, you can code the terminal block and the module using studs. The purpose of the studs is to prevent the terminal block from being mounted on another module. Handling errors can then be avoided when replacing a module.

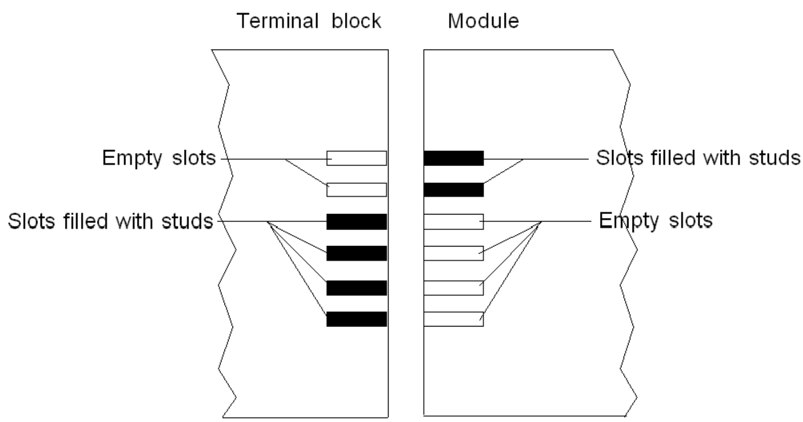
Coding is done by the user with the STB XMP 7800 guidance wheel's studs. You can only fill the 6 slots in the middle of the left side (as seen from the wiring side) of the terminal block, and can fill the module's 6 guidance slots on the left side.

To fit the terminal block to the module, a module slot with a stud must correspond to an empty slot in the terminal block, or a terminal block with a stud must correspond to an empty slot in the module. You can fill up to and including either of the 6 available slots as desired.

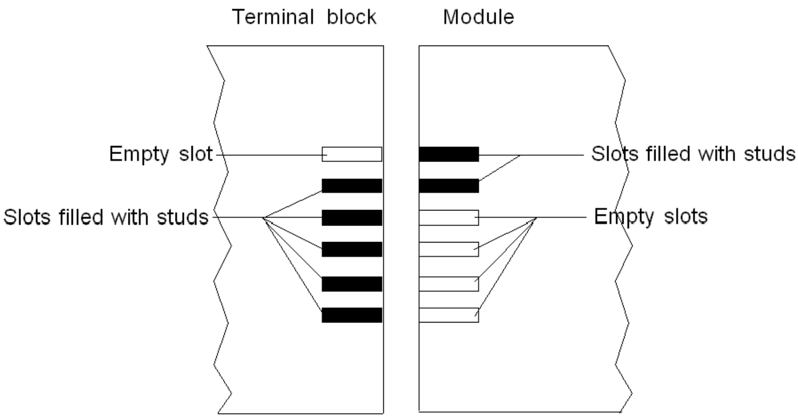
The diagram below shows a guidance wheel as well as the slots on the module used for coding the 20-pin terminal blocks:



The diagram below shows an example of a coding configuration that makes it possible to fit the terminal block to the module:



The diagram below shows an example of coding configuration with which it is not possible to fit the terminal block to the module:



⚠ DANGER

ELECTRICAL SHOCK

Terminal block must be connected or disconnected with sensor and pre-actuator voltage switched off.

Failure to follow these instructions will result in death or serious injury.

NOTICE

POTENTIAL MODULE DAMAGE

Code the terminal block as described above to prevent the terminal block from being mounted on an incorrect module. Mounting a terminal block on an incorrect module may damage the module.

Plugging the wrong connector could cause the module to be destroyed.

Failure to follow these instructions can result in equipment damage.

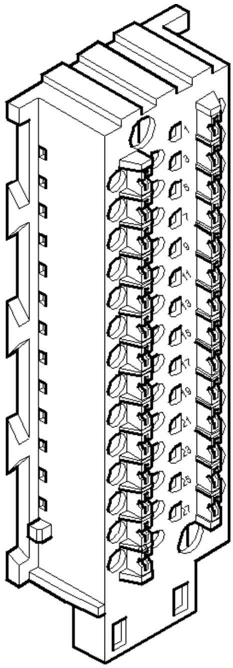
⚠ CAUTION
UNEXPECTED BEHAVIOR OF APPLICATION
Code the terminal block as described above to prevent the terminal block from being mounted on another module.
Plugging the wrong connector could cause unexpected behavior of the application.
Failure to follow these instructions can result in injury or equipment damage.

NOTE: The module connector have indicators which show the proper direction to use for terminal block installation.

Fitting a 28-Pin Terminal Block to an Analog Module

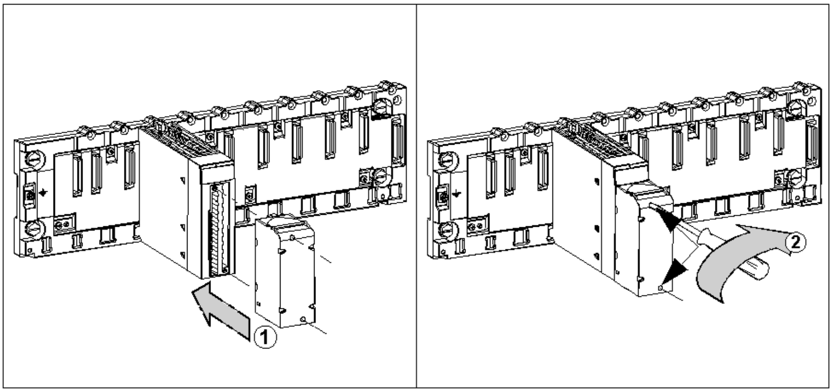
At a Glance

The BMX AMI 0800 and BMX AMI 0810 modules require a 28-pin terminal block witch is inserted into the front of the module. These fitting operations (assembly and disassembly) are described below.



Installing the 28-Pin Terminal Block

The following table shows the procedure for assembling the 28-pin terminal block onto BMX AMI 0800 and BMX AMI 0810 analog modules:



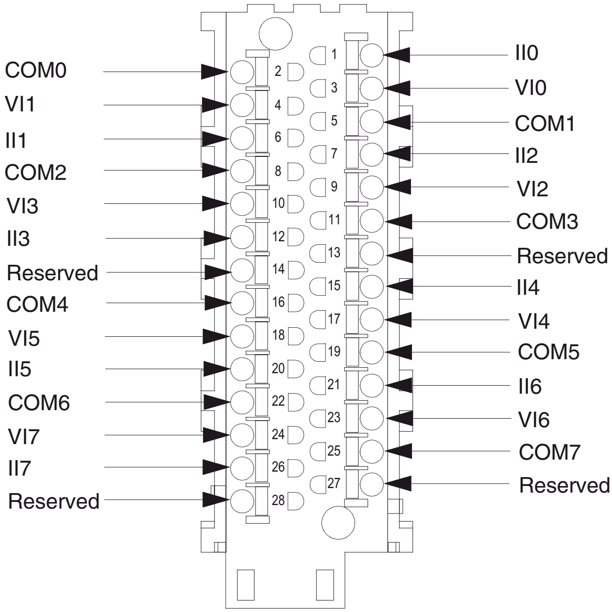
Assembly procedure:

Step	Action
1	Once the module is in place on the rack, install the terminal block by inserting the terminal block encoder (the rear lower part of the terminal) into the module's encoder (the front lower part of the module), as shown above.
2	Fix the terminal block to the module by tightening the 2 mounting screws located on the lower and upper parts of the terminal block. Tightening torque: 0.4 N.m.

NOTE: If the screws are not tightened, there is a risk that the terminal block will not be properly fixed to the module.

28-Pin Terminal Block Arrangements

The following graphic shows the 28-Pin terminal block arrangement:



⚠ CAUTION
Electrical hazard
Follow the wiring *(see Modicon M340, BMX MSP 0200 (PTO) module, Unity Pro)*, mounting and installation *(see Modicon M340, BMX MSP 0200 (PTO) module, Unity Pro)* instructions.
Failure to follow these instructions can result in injury or equipment damage.

20-Pin Terminal Block Modules

At a Glance

The BMX AMI 0410, BMX AMO 0210, BMX AMO 0410, BMX AMO 0802 and BMX AMM 0600 modules are supplemented by a 20-pin terminal block.

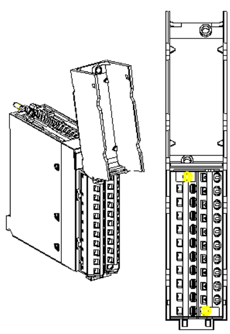
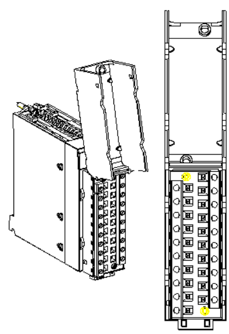
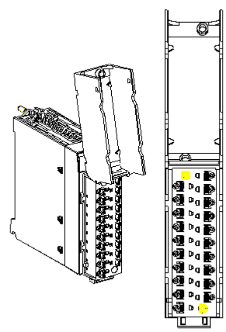
There are three types of 20-pin terminal blocks:
- BMX FTB 2010 screw clamp terminal blocks,
- BMX FTB 2000 caged terminal blocks,
- BMX FTB 2020 spring terminal blocks.

Cable Ends and Contacts

Each terminal block can accommodate:
- Bare wires
- Wires with DZ5-CE type cable ends: 

Description of the 20-Pin Terminal Blocks

The table below shows the description of the three types of 20-pin terminal blocks:

	Screw clamp terminal blocks	**Caged terminal blocks**	**Spring terminal blocks**
Illustration			
Number of wires accommodated	2	1	1

		Screw clamp terminal blocks	**Caged terminal blocks**	**Spring terminal blocks**
Number of wire gauges accom-modated	minimum	AWG 24 (0.34 mm^2)		
	maximum	AWG 16 (1.5 mm^2)		
Wiring constraints		Screw clamps have slots that accept: ● flat-tipped screwdrivers with a diameter of 5 mm, ● posidriv n° 1 cross-tipped screwdrivers. Screw clamp terminal blocks have captive screws. On the supplied blocks, these screws are not tightened.	Caged terminal blocks have slots that accept: ● flat-tipped screwdrivers with a diameter of 3 mm, ● posidriv n° 1 cross-tipped screwdrivers. Caged terminal blocks have captive screws. On the supplied blocks, these screws are not tightened.	The wires are connected by pressing on the button located next to each pin. To press on the button, you have to use a flat-tipped screwdriver with a maximum diameter of 3 mm.
Maximum screw tightening torque		0.5 N•m (0.37 lb-ft).	0.5 N•m (0.37 lb-ft).	-

⚠ DANGER

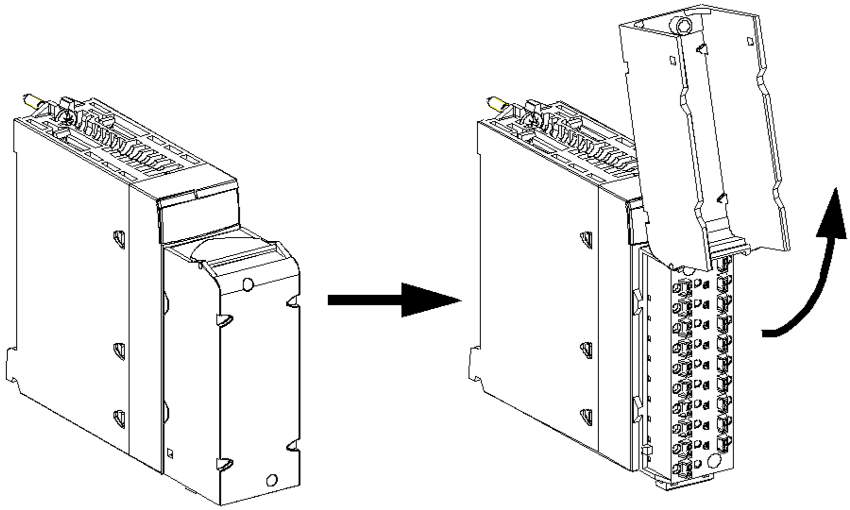
ELECTRICAL SHOCK

The terminal block must be connected or disconnected with sensor and pre-actuator voltage switched off.

Failure to follow these instructions will result in death or serious injury.

Connection of 20-Pin Terminal Blocks

The following diagram shows the method for opening the 20-pin terminal block door so that it can be wired:



The connection cables for 20-pin terminal blocks come in 3 kinds of connections:

- Connection cables with a FTB connector, which come in 2 different lengths:
  - 3 meter: BMX FTW 301S,
  - 5 meter: BMX FTW 501S.
- Connection cables with a FTB and a D-Sub25 connectors for direct wiring of BMX AMI 0410 module with Telefast ABE7CPA410 or BMX AMO 0210 and BMX AMO 0410 modules with Telefast ABE7CPA21, which come in 3 different lengths:
  - 1.5 meter: BMX FCA 150,
  - 3 meter: BMX FCA 300,
  - 5 meter: BMX FCA 500.
- Connection for BMXAMO0802 with Telefast ABE7CPA02 using 2 different lengths:
  - 1.5 meter: BMX FTA 152,
  - 3 meter: BMX FTA 302,

NOTE: The connection cable is installed and held in place by a cable clamp positioned below the 20-pin terminal block.

Labeling of 20-Pin Terminal Blocks

Labels for the 20-pin terminal blocks are supplied with the module. They are to be inserted in the terminal block cover by the customer.

Each label has two sides:

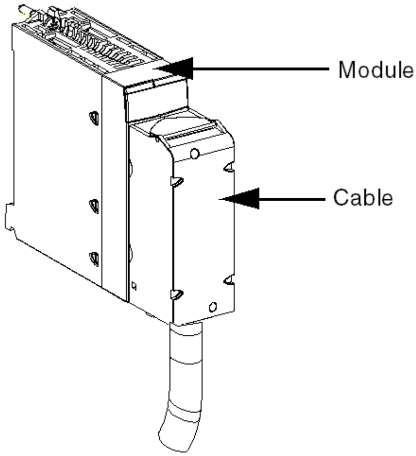
- One side that is visible from the outside when the cover is closed. This side features the commercial product references, an abbreviated description of the module, as well as a blank section for customer labeling.
- One side that is visible from the inside when the cover is open. This side shows the terminal block connection diagram.

How to Connect Analog Input/Output Modules: Connecting 20-pin Terminal Block Modules

Introduction

20-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable trouble-free direct wire to wire transition of the module's inputs/outputs.

The following diagram shows the connection of the cable to the module:



⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

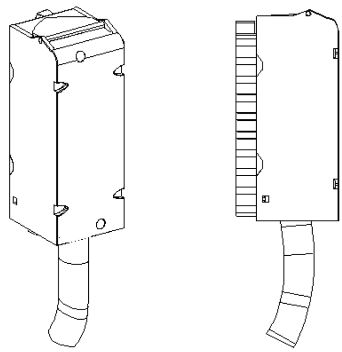
Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

BMX FTW ••1S Connection Cables

They are made up of:

- At one end, a compound-filled 20-pin connector from which extend 1 cable sheath, containing 20 wires with a cross-sectional area of 0.34 mm^2 (AWG 24),



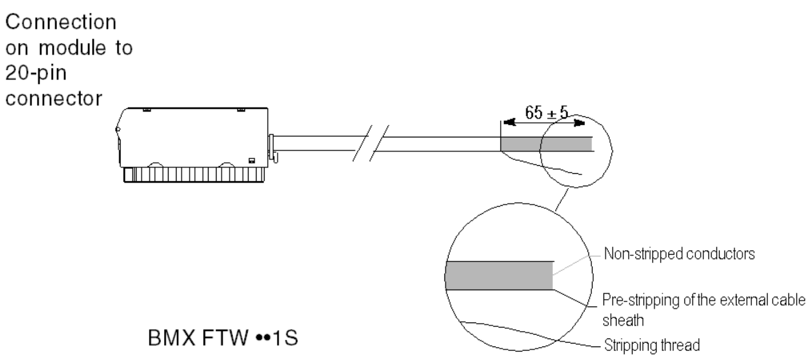
BMX FTW ••1S

- At the other end, free wire ends differentiated by color code.

The cable comes in 2 different lengths:

- 3 meters: BMX FTW 301S;
- 5 meters: BMX FTW 501S;

The figure below shows the BMX FTW ••1S cables:

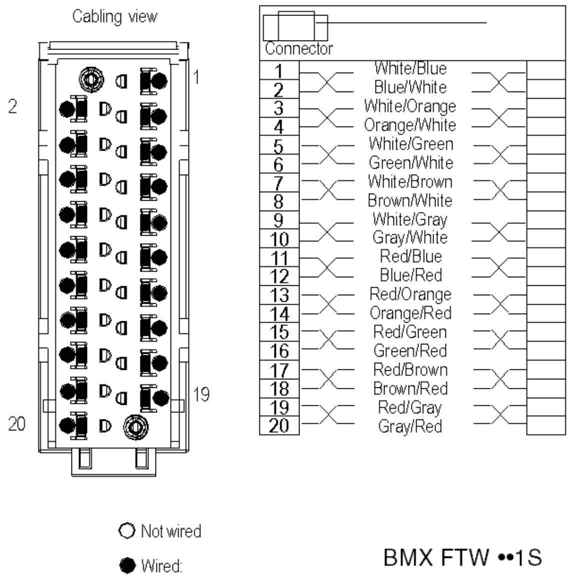


NOTE: A strand of nylon incorporated in the cable allows the cable sheath to be stripped with ease.

NOTE: The 20-pin connectors must be connected or disconnected with sensor and pre-actuator voltage switched off.

Connection of BMX FTW ••1S Cables

The diagram below shows the connection of BMX FTW ••1S cable:



28-Pin Terminal Block Modules

At a Glance

The BMX AMI 0810 and BMX AMI 0800 modules are supplemented by a 28-pin terminal block.

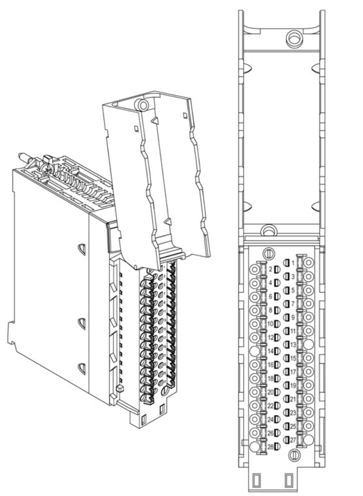
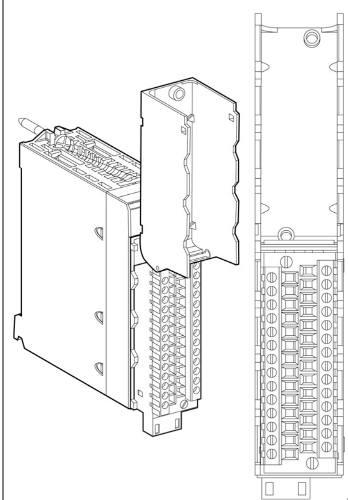
There are two types of 28-pin terminal blocks:
- BMX FTB 2820 spring terminal blocks.
- BMX FTB 2800 caged terminal blocks.

Cable Ends and Contacts

The terminal block can accommodate:
- Bare wires
- Wires with DZ5-CE type cable ends:

Description of the 28-Pin Terminal Blocks

The table below shows the description of the 28-pin terminal blocks:

	Spring terminal blocks	Caged terminal blocks
Illustration		
Number of wires accommodated	1	1

		Spring terminal blocks	Caged terminal blocks
Number of wire gauges accom-modated	minimum	AWG 24 (0.34 mm^2)	
	maximum	AWG 16 (1.5 mm^2)	
Wiring constraints		The wires are connected by pressing on the button located next to each pin. To press on the button, you have to use a flat-tipped screwdriver with a maximum diameter of 3 mm.	Caged terminal blocks have solts that accept: • flat-tipped screwdrivers with a diameter of 3 mm, • posidriv nº1 cross-tipped screwdrivers. Caged terminal blocks have captive screws. On the supplied blocks,these screws are not tightened.
Maximum screw tightening torque		-	0.5 N•m (0.37 lb-ft)

⚠ DANGER

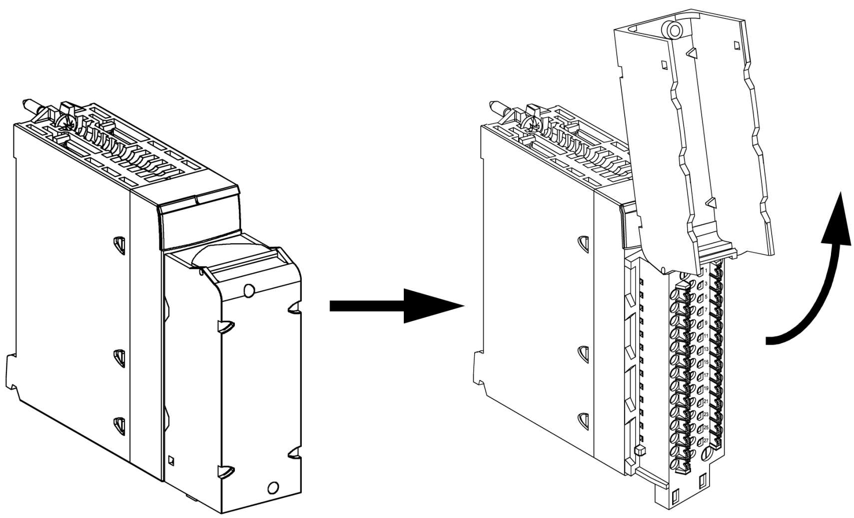
ELECTRICAL SHOCK

The terminal block must be connected or disconnected with sensor and pre-actuator voltage switched off.

Failure to follow these instructions will result in death or serious injury.

Connection of 28-Pin Terminal Blocks

The following diagram shows the method for opening the 28-pin terminal block door so that it can be wired:



The connection cables for 28-pin terminal blocks come in 2 kinds of connections:

- Connection cables with a FTB connector, which come in 2 different lengths:
  - 3 meter: BMX FTW 308S,
  - 5 meter: BMX FTW 508S.
- Connection cables with a FTB and a D-Sub25 connectors for direct wiring of BMX AMI 0800 module with Telefast ABE 7CPA02/03/31E or BMX AMI 0810 modules with Telefast ABE 7CPA02/31/31E, which come in 2 different lengths:
  - 1.5 meter: BMX FTA 150,
  - 3 meter: BMX FTA 300,

NOTE: The connection cable is installed and held in place by a cable clamp positioned below the 28-pin terminal block.

Labeling of 28-Pin Terminal Blocks

Labels for the 28-pin terminal blocks are supplied with the module. They are to be inserted in the terminal block cover by the customer.

Each label has two sides:

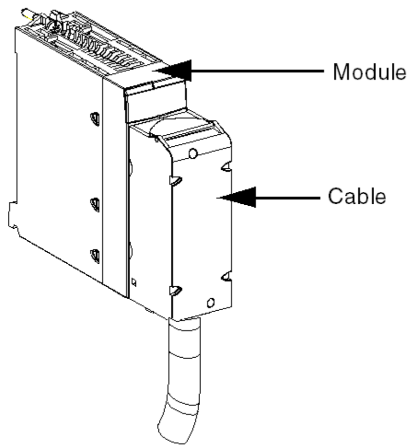
- One side that is visible from the outside when the cover is closed. This side features the commercial product references, an abbreviated description of the module, as well as a blank section for customer labeling.
- One side that is visible from the inside when the cover is open. This side shows the terminal block connection diagram.

How to Connect Analog Input/Output Modules: Connecting 28-pin Terminal Block Modules

Introduction

28-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable trouble-free direct wire to wire transition of the module's inputs/outputs.

The following diagram shows the connection of the cable to the module:

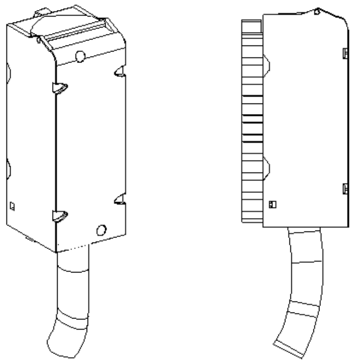


⚠ WARNING
UNEXPECTED EQUIPMENT OPERATION Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

BMX FTW ••8S Connection Cables

They are made up of:

- At one end, a compound-filled 28-pin connector from which extend 1 cable sheath, containing 24 wires with a cross-sectional area of 0.34 mm^2 (AWG 24),



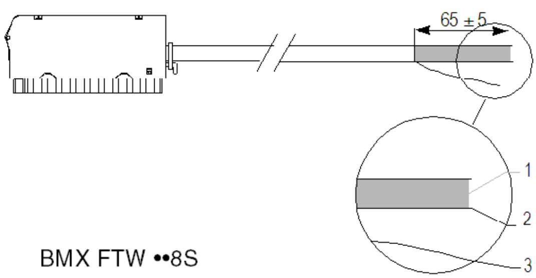
BMX FTW ••8S

- At the other end, free wire ends differentiated by color code.

The cable comes in 2 different lengths:

- 3 meters: BMX FTW 308S;
- 5 meters: BMX FTW 508S;

The figure below shows the 28-pin connector cable free wire ends :



BMX FTW ••8S

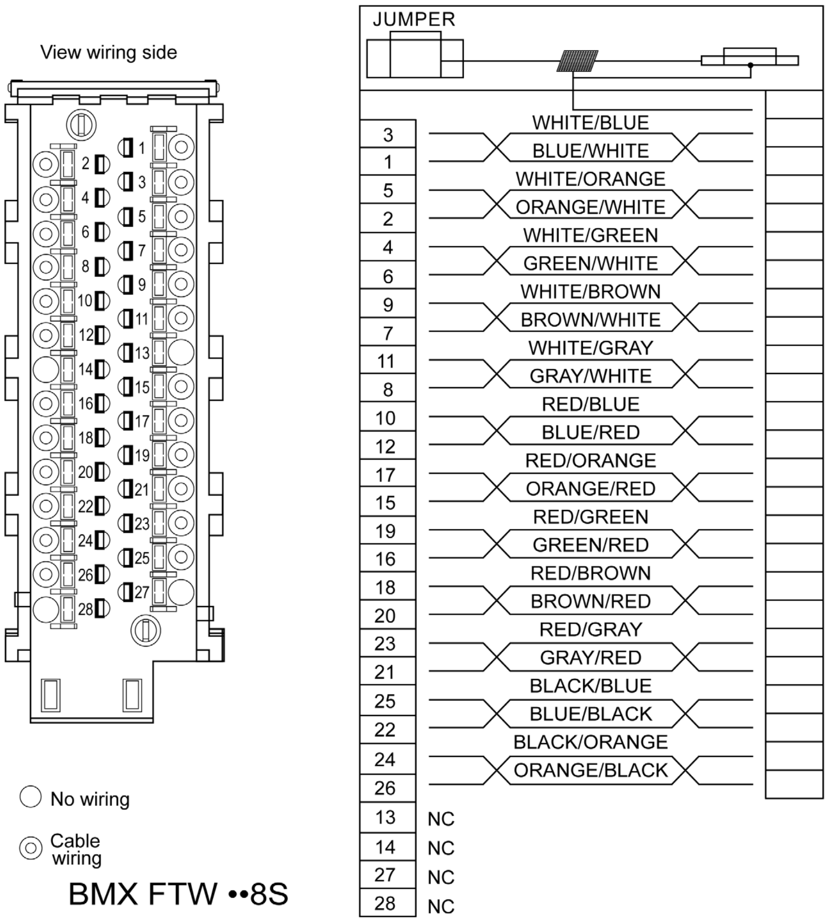
1 Non-shipped conductors
2 Pre-stripping of the external cable shealth
3 Stripping thread

NOTE: A strand of nylon incorporated in the cable allows the cable sheath to be stripped with ease.

NOTE: The 28-pin connectors must be connected or disconnected with sensor and pre-actuator voltage switched off.

Connection of BMX FTW ••8S Cables

The diagram below shows the connection of BMX FTW ••8S cable:

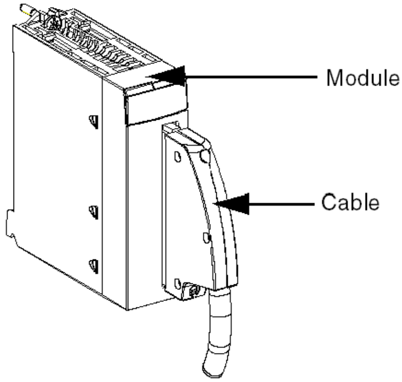


How to Connect Analog Input/Output Modules: Connecting 40-pin Connector Modules

Introduction

40-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable trouble-free direct wire to wire transition of the module's inputs/outputs.

The following diagram shows the connection of the cable to the module:



⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

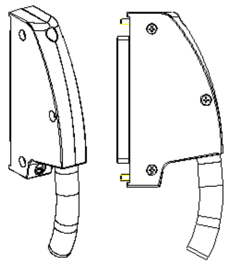
Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

BMX FCW ••1S Connection Cables

They are made up of:

- At one end, a compound-filled 40-pin connector from which extend 1 cable sheath, containing 20 wires with a cross-sectional area of 0.34 mm^2 (AWG 24),



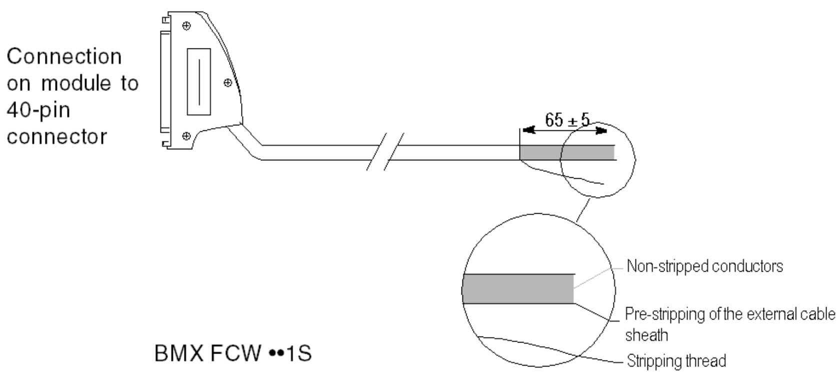
BMX FCW ••1S

- At the other end, free wire ends differentiated by color code.

The cable comes in 2 different lengths:

- 3 meters: BMX FCW 301S,
- 5 meters: BMX FCW 501S.

The figure below shows the BMX FCW ••1S cables:

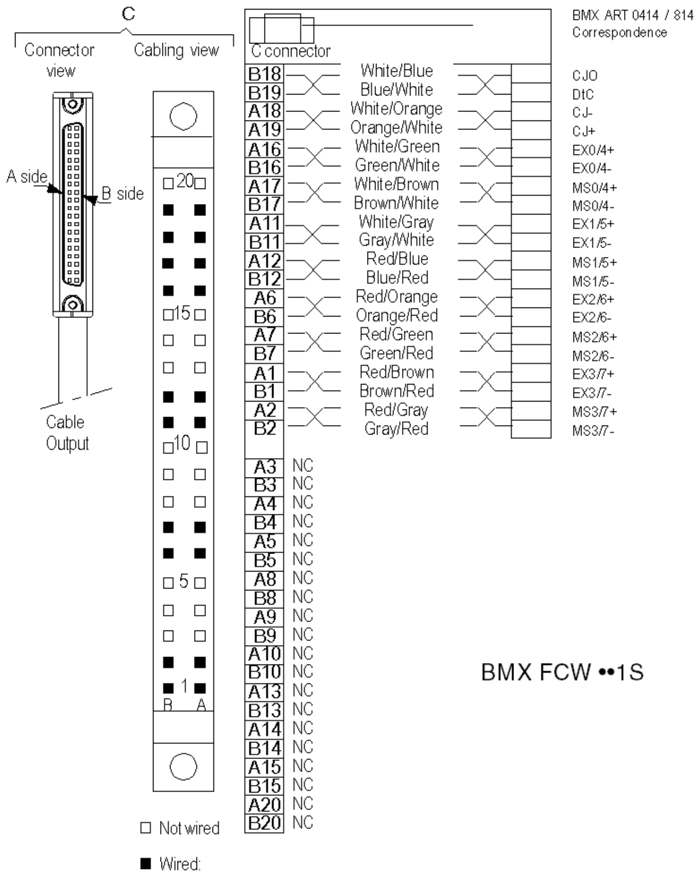


NOTE: A strand of nylon incorporated in the cable allows the cable sheath to be stripped with ease.

NOTE: The 40-pin connectors must be connected or disconnected with sensor and pre-actuator voltage switched off.

Connection of BMX FCW ••1S Cables

The diagram below shows the connection of BMX FCW ••1S cable and the signals correspondence for the BMX ART 0414/814 modules:



TELEFAST Wiring Accessories Dedicated to Analog Modules

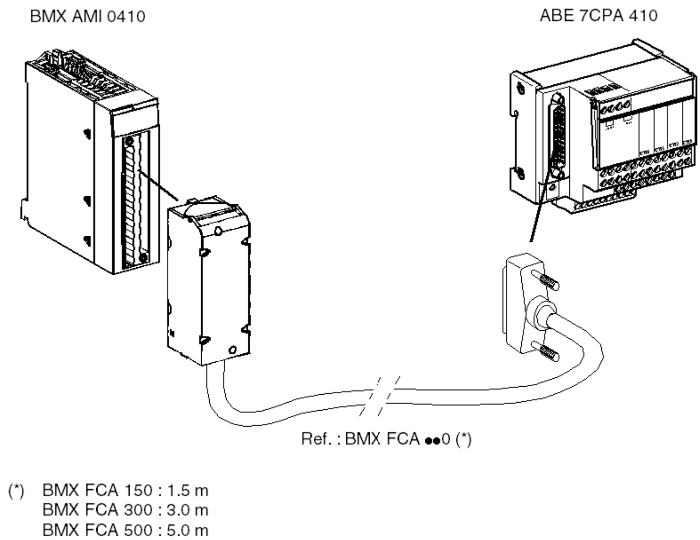
At a Glance

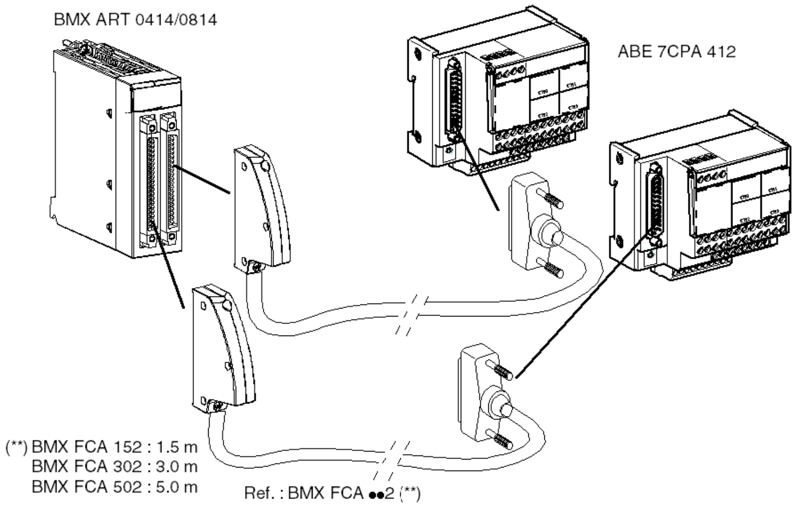
Two TELEFAST wiring accessories are available:

- **ABE-7CPA410**: specifically designed for the **BMX AMI 0410** module. In addition to distributing 4 channels to the screw terminal blocks.
  It is also used to:
  - Supply, channel by channel, sensors with a protected 24 V, current limited to 25 mA/channel, while maintaining isolation between the module channels.
  - Protect current shunts contained in the modules against over voltage.
- **ABE-7CPA412**: specifically designed for the **BMX ART 0414/0814** module. It distributes 4 or 8 channels from one to two 40-pin FCN connectors for connecting thermocouples. It includes a cold junction compensation circuit at 1.5° C (2.7° F). All four or eight channels may be used.
  When extending to an intermediary isothermal terminal block, it is possible to carry out a cold junction compensation by connecting to channel 0, by either:
  - dedicating channel 0 to 2 -3 wire Pt100 for CJC.
  - using the CJC values of channels 4/7 for channels 0/3.l.

Illustration

The analog module may be connected to the TELEFAST accessories using a 5-, 3- or 1.5-meter shielded cable.





Modicon M340H (Hardened) Equipment

M340H

The Modicon M340H (hardened) equipment is a ruggedized version of M340 equipment. It can be used at extended temperatures (-25...70ºC) (-13...158ºF) and in harsh chemical environments.

This treatment increases the isolation capability of the circuit boards and their resistance to:

- condensation
- dusty atmospheres (conducting foreign particles)
- chemical corrosion, in particular during use in sulphurous atmospheres (oil, refinery, purification plant and so on) or atmospheres containing halogens (chlorine and so on)

The M340H equipment, when within the standard temperature range (0...60ºC) (32...140ºF), has the same performance characteristics as the standard M340 equipment.

At the temperature extremes (-25... 0ºC and 60... 70ºC) (-13...32ºF) and (140...158ºF) the hardened versions can have reduced power ratings that impact power calculations for Unity Pro applications.

If this equipment is operated outside the -25...70ºC (-13...158ºF) temperature range, the equipment can operate abnormally.

⚠ CAUTION
UNINTENDED EQUIPMENT OPERATION
Do not operate M340H equipment outside of its specified temperature range.
Failure to follow these instructions can result in injury or equipment damage.

Hardened equipment has a conformal coating applied to its electronic boards. This protection, when associated with appropriate installation and maintenance, allows it to be more robust when operating in harsh chemical environments.

Diagnostics for Analog Modules

2

Subject of this Section

This section explains the processing of hardware detected faults related to analog input and output modules.

What Is in This Chapter?

This chapter contains the following topics:

Display of Analog Module States

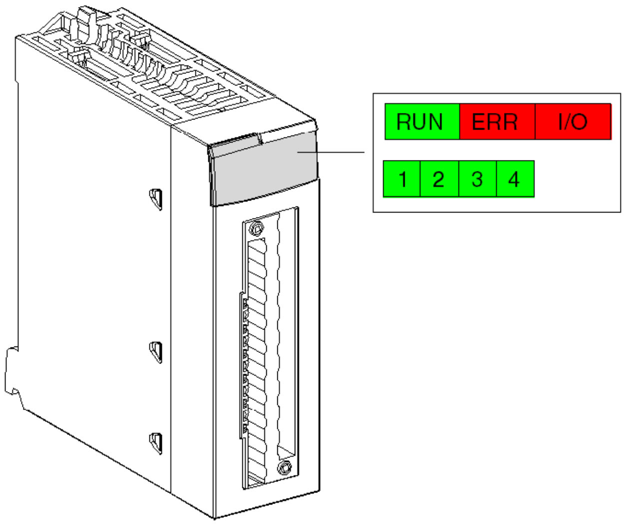
At a Glance

Analog modules have LEDs which show the module's status and the status of the channels. These are:

- Module status LEDs: RUN, ERR and I/O.
- Channels status LEDs: IN • (for input modules), OUT • (for output modules).

Description

The modules have several LEDs that indicate their status:



Description of the LEDs:

LED	Meaning
RUN (green)	Module operating status
ERR (red)	Internal detected error in the module or a conflict between the module and the remainder of the configuration.
I/O (red)	External error

Analog Module Diagnostics

At a Glance

The status of the analog module is indicated by the lighting up or flashing of the RUN, ERR, I/O and channel LEDs.

Description

The following table allows you to perform diagnostics of the module status according to the LEDs: RUN, ERR, I/O and channels:

Module status	Status LEDs			
	RUN	ERR	I/O	IN • or OUT •
Operating normally	●	○	○	●
Module is running with channels in stopped state	●	○	○	○
Module is inoperative or switched off	○	○	○	○
Module not configured or channel configuration in progress	⊗	○	○	○
Internal error in module	○	●	○	○
Module not calibrated to factory settings (1)	●	○	●	○
Module is experiencing difficulties communicating with the CPU (1)	●	⊗	○	●
Module not configured	○	⊗	○	○
External error: • Range under/overflow error. • Sensor or actuator link error.	 ● ●	 ○ ○	 ● ●	 ⊗ (2) ⨂ (2)
Legend:				
○ LED off				
⊗ LED flashing				
⨂ LED flashing rapidly				
● LED on				
(1) only on the BMX AMO 0210 module				
(2) one or more LEDs				

BMX AMI 0410 Analog Input Module

3

Subject of this Chapter

This chapter presents the BMX AMI 0410 module, its characteristics, and explains how it is connected to the various sensors.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

The BMX AMI 0410 module is a high-level, 4-input industrial measurement device.

Used in conjunction with sensors or transmitters, it performs monitoring, measurement, and continuous process control functions.

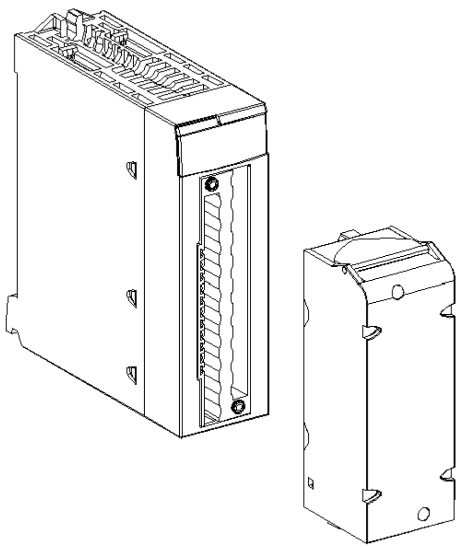
The BMX AMI 0410 module offers the following range for each input, according to the selection made during configuration:

- Voltage +/-10 V/0..5 V/0..10 V/1..5 V/+/- 5 V
- Current 0..20 mA/4..20 mA/+/- 20 mA

The module operates with voltage inputs. It includes four read resistors connected to the terminal block to perform current inputs.

Illustration

BMX AMI 0410 analog input module looks like this.



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMI 0410 and BMX AMI 0410H *(see page 45)* modules are as follows.

Type of inputs		Isolated high level inputs
Nature of inputs		Voltage / Current (250 Ω internally protected resistors)
Number of channels		4
Acquisition cycle time:		
• Fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• Default (periodic acquisition for all channels)		5 ms
Display resolution		16-bit
Digital filtering		1st order
Isolation: • Between channels • Between channels and bus • Between channels and ground		 +/-300 VDC 1400 VDC 1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 90 mA Protected for accidental: -19.2 - 30 VDC wiring
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.82 W
	Maximum	1.30 W

Measurement Range

The BMX AMI 0410 and BMX AMI 0410H *(see page 45)* analog inputs have the following measurement range characteristics:

Measurement range	**+/-10 V; +/-5 V; 0..10 V; 0..5 V; 1..5 V**	**0..20 mA; 4..20 mA; +/- 20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.35 mV	0.92 µA
Input impedance	10 MΩ	250 Ω Internal conversion resistor
Precision of the internal conversion resistor	-	0.1% - 15 ppm/° C
Measurement errors for standard module:		
• At 25° C • Maximum in the temperature range 0...60° C (32...140° F)	0.075% of FS (1) 0.1% of FS (1)	0.15% of FS (1)(2) 0.3% of FS (1)(2)
Measurement errors for Hardened module:		
• At 25° C • Maximum in the temperature range -25...70° C (-13...158° F)	0.075% of FS (1) 0.2% of FS (1)	0.15% of FS (1)(2) 0.55% of FS (1)(2)
Temperature drift	15 ppm/° C	30 ppm/° C
Monotonicity	Yes	Yes
Crosstalk between channels DC and AC 50/60Hz	> 80dB	> 80dB
Non-linearity	0.001% of FS	0.001% of FS
Repeatability @25° C of 10 min. stabilization time	0.005% of FS	0.007% of FS
Long term stability after 1000 hours	< 0.004% of FS	< 0.004% of FS
Legend: (1) FS: Full Scale (2) With conversion resistor error		

NOTE: If nothing is connected on a BMX AMI 0410 analog module and if channels are configured (range 4-20 mA or 1-5 V), a broken wire causes a detected I/O error.

Functional Description

Function

The BMX AMI 0410 module is a high-level, 4-input industrial measurement device.

Used in conjunction with sensors or transmitters, it performs monitoring, measurement, and continuous process control functions.

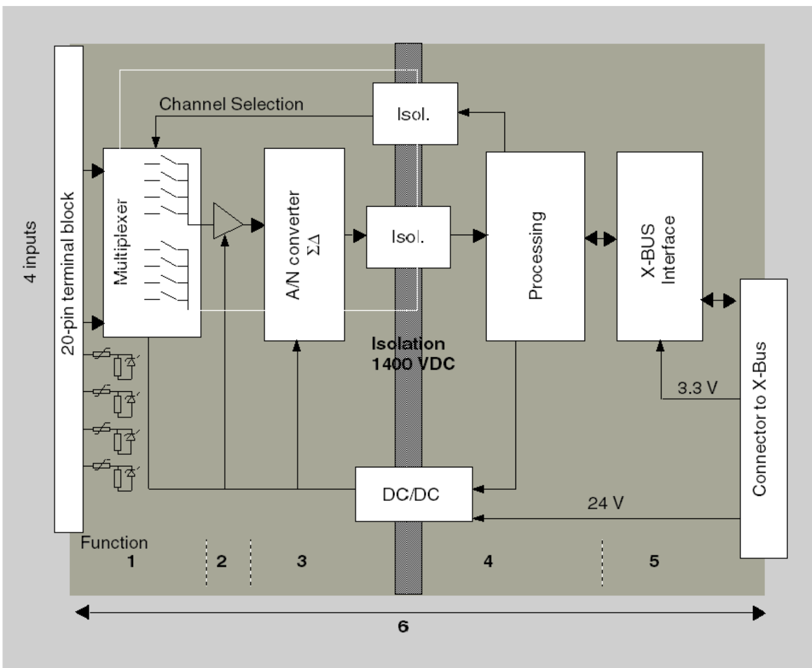
The BMX AMI 0410 module offers the following range for each input, according to the selection made during configuration:

- +/-10 V
- 0..10 V
- 0..5 V / 0..20 mA
- 1..5 V / 4..20 mA
- +/- 5 V +/- 20 mA

The module operates with voltage inputs. It includes four read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0410 module's illustration is as follows.



Description.

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 20-pin screw terminal block. • Protection of the module against overvoltages. • Protection of the current reading resistors using limiters and resettable fuses. • Input signal analog filtering. • Scan input channels using static multiplexing through opto-switches, in order to provide the possibility of common mode voltage of +/- 300 VDC.
2	**Amplifying Input Signals**	• Gain selecting, based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current). • Compensation of drift in amplifier device.
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a $\Sigma\Delta$ converter.
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients. • (Numeric) filtering of measurements, based on configuration parameters. • Scaling of measurements, based on configuration parameters.
5	**Communicating with the Application**	• Manages exchanges with CPU. • topological addressing. • Receives configuration parameters from module and channels. • Sends measured values, as well as module status, to application.
6	**Module monitoring and sending error notification back to application.**	Conversion string test. Testing for range overflow on channels. Watchdog test.

Measurement Timing

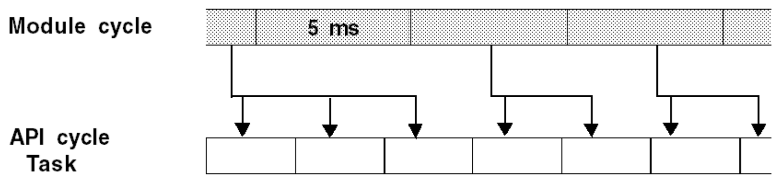
The timing of measurements is determined by the cycle selected during configuration: Normal or Fast Cycle.

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels In Use.

The cycle time values are based on the cycle selected.

Module	Normal Cycle	Fast Cycle
BMX AMI 0410	5 ms	1 ms + (1 ms x N) where N: number of channels in use.

NOTE: Module cycle is not synchronized with the PLC cycle. At the beginning of each PLC cycle, each channel value is taken into account. If the MAST/FAST task cycle time is less than the module's cycle time, some values will not have changed.

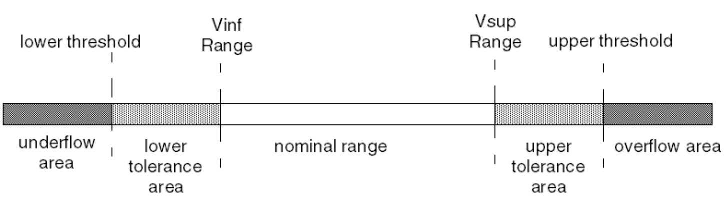


Overflow/Underflow Control

Module BMX AMI 0410 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected, the module checks for overflow: it verifies that the measurement falls between a lower and an upper threshold.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Upper Tolerance Area	varies between the values included between the maximum value for the range (for instance: +10 V for the +/-10 V range) and the upper threshold
Lower Tolerance Area	varies between the values included between the minimum value for the range (for instance: -10 V for the +/-10 V range) and the lower threshold
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits.

Range	BMX AMI 0410 Range									
	Underflow Area		Lower Tolerance Area		Nominal Range		Upper Tolerance Area		Overflow Area	
Unipolar										
0...10 V	-1,400	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,400	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

The lower and upper thresholds must be integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1 - \alpha) \times Val_{b(n)}$$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

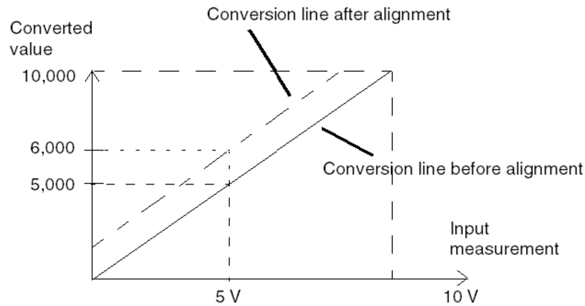
The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.0025 / T 0.0012 / T

Sensor Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Replacing a module does not therefore require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- view and modify the desired measurement value
- save the alignment value
- determine whether the channel already has an alignment

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in standard operating mode, without any effect on the channel's operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

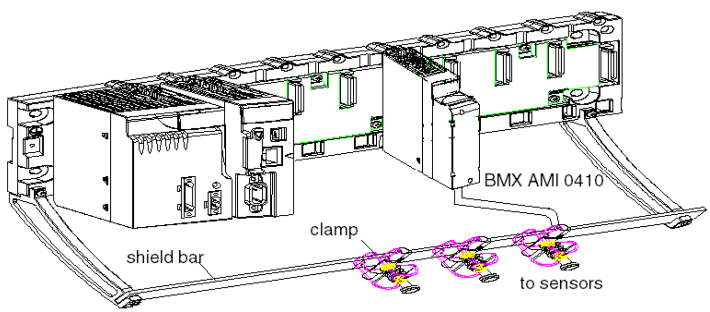
Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

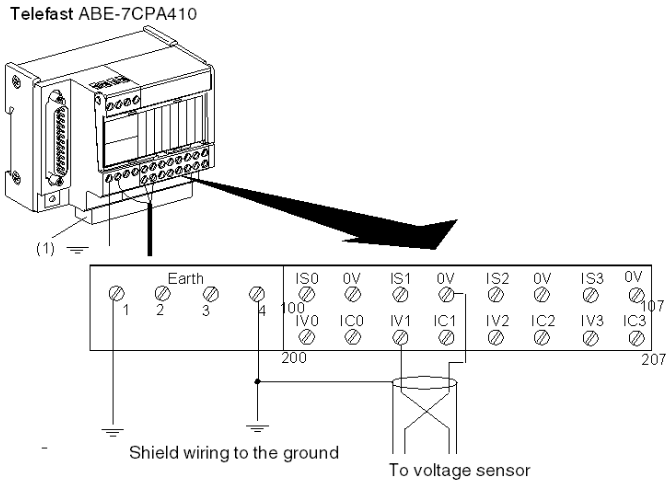
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



- TELEFAST connection:
  Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



(1) The grounding of cables is facilited using the ABE-7BV10 accessory.

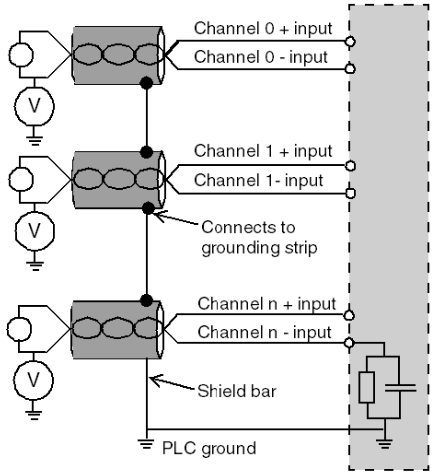
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, we recommend you take the following precautions:

- sensors must be close together (a few meters)
- all sensors must be referenced to a single point, which is connected to the PLC’s ground

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in the following diagram:



If the sensors are referenced in relation to the ground, this may in some cases return a remote ground potential to the terminal block. It is therefore **essential** to follow the following rules:

- The potential must be less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground.

Ensure that:
- potentials greater than permitted low limits cannot exist,
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

CAUTION
UNEXPECTED BEHAVIOR OF APPLICATION Follow those instructions to reduce electromagnetic perturbations: • use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding. Electromagnetic perturbations may lead to an unexpected behavior of the application. **Failure to follow these instructions can result in injury or equipment damage.**

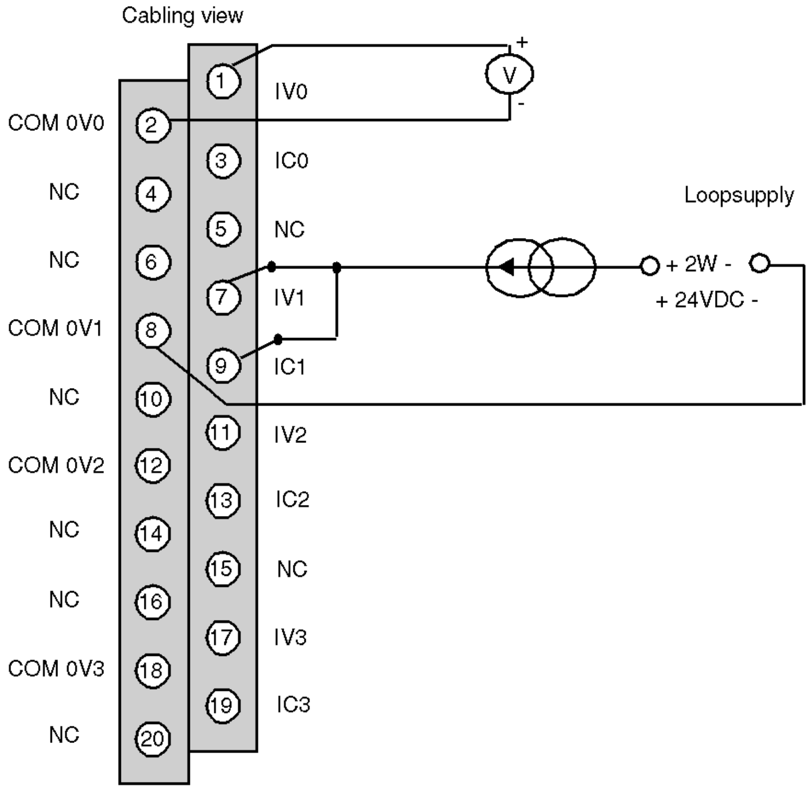
Wiring Diagram

Introduction

Module BMX AMI 0410 is connected using the 20-point terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows.



IVx + pole input for channel x
COM 0Vx - pole input for channel x
ICx current reading resistor + input
Channel 0 voltage sensor
Channel 1 2-wire current sensor

Use of the TELEFAST ABE-7CPA410 Wiring Accessory

At a Glance

The TELEFAST ABE-7CPA410 accessory is a base unit used for the connection of sensors. It has the following functions:

- Extend the input terminals in voltage mode.
- Supply, channel by channel, the 0-20 mA or 4-20 mA sensors with a protected 24 V voltage, limited in current to 25 mA, while maintaining isolation between the channels.
- Protect current reading resistors that are integrated in TELEFAST against overvoltage.

Channels to channels isolation	750 Vdc
Channels to 24Vdc supply isolation	750Vdc
Overvoltage protection on current inputs	By Zener diodes 8,2V

NOTE: When using current inputs, the TELEFAST 250 Ohm resistors are used, as opposed to those of the module. The BMX AMI 0410 module operates in voltage mode.

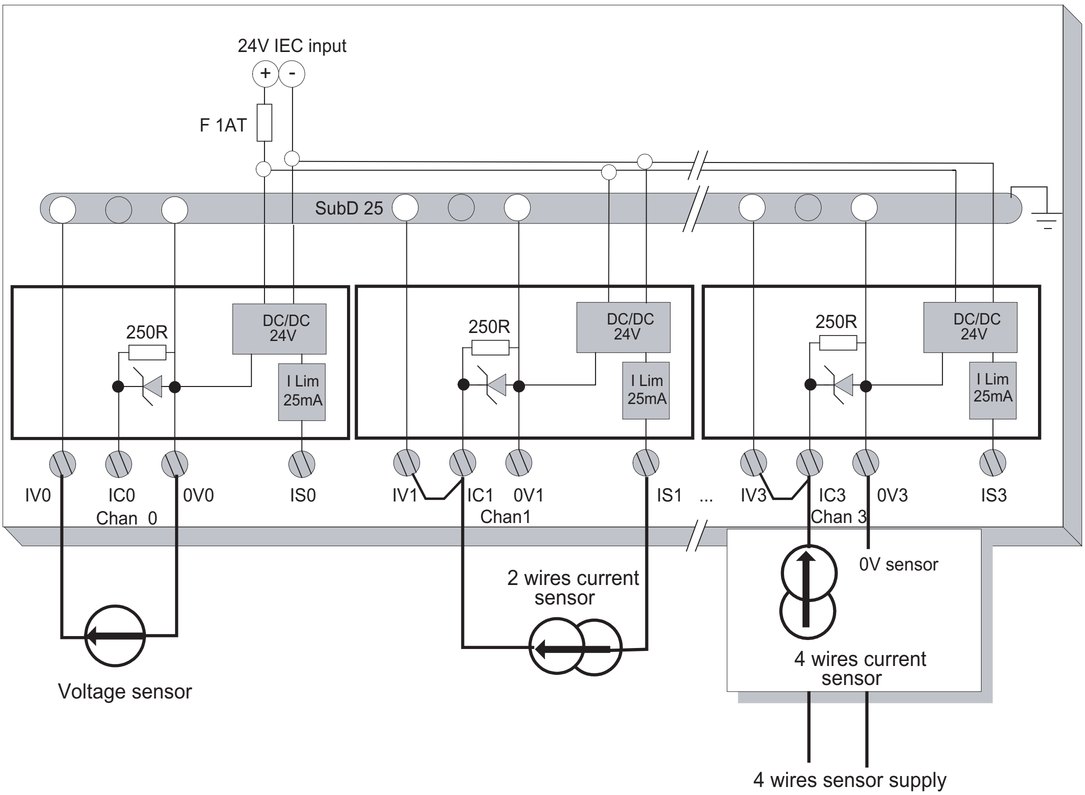
Connecting Sensors

Sensors may be connected to the ABE-7CPA410 accessory as shown in the illustration. *(see page 62)*

The following table shows the ABE7-CPA410 and SUBD25 terminal numbers:

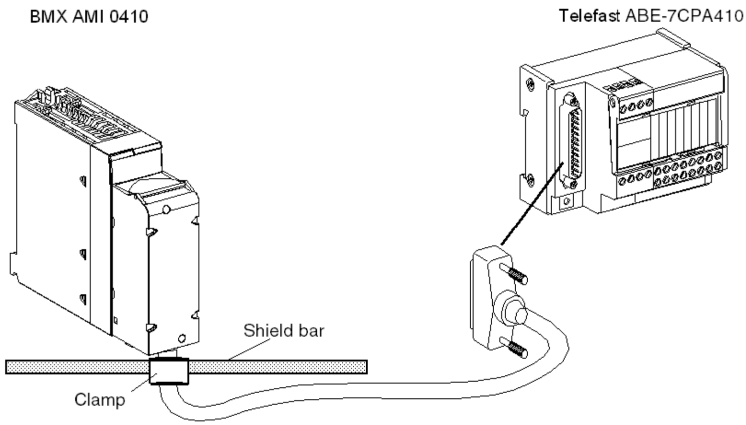
Terminal Numbers	SUBD25	Description	Terminal Numbers	SUBD25	Description
1	/	Earth	/		24 VDC Input
2	/	Earth	/		24 VDC Input
3	/	Earth	/		0V24 Input
4	/	COM 0	/		0V24 Input
100		Output IS 0	101	14	COM 0V0
102		Output IS 1	103	3	COM 0V1
104		Output IS 2	105	17	COM 0V2
106		Output IS 3	107	6	COM 0V3
200	1	Output IV 0	201		Input IC 0
202	15	Output IV 1	203		Input IC 1
204	4	Output IV 2	205		Input IC 2
206	18	Output IV 3	207		Input IC 3

Wiring diagram:



Connecting Modules

Modules can be connected to a TELEFAST ABE-7CPA410 as shown in the diagram below.



The BMX AMI 0410 analog module may be connected to the TELEFAST ABE-7CPA410 accessory using one of the following cables:

- BMX FCA 150: length 1.5 m
- BMX FCA 300: length 3 m
- BMX FCA 500: length 5 m

BMX AMI 0800 Analog Input Module

4

Subject of this Chapter

This chapter presents the BMX AMI 0800 module, its characteristics, and explains how it is connected to the various sensors.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

The BMX AMI 0800 is a high density input analog module with 8 non-isolated channels.

This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

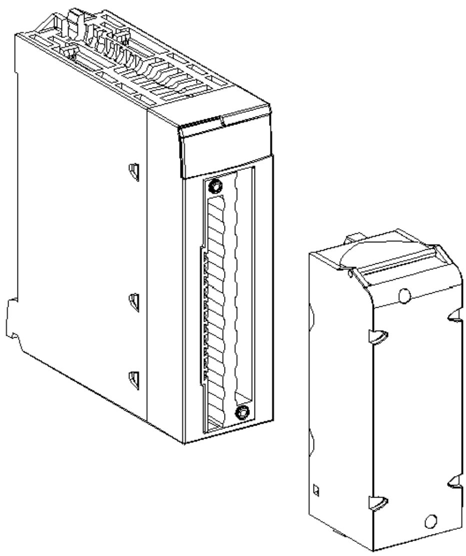
The BMX AMI 0800 module offers the following range for each input according to the selection made during configuration:

- Voltage +/-5 V/+/-10 V/0..5 V/0..10 V/1..5 V
- Current +/-20 mA/0..20 mA/4..20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The following graphic shows the BMX AMI 0800 analog input module:



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMI 0800 and BMX AMI 0800H *(see page 45)* modules are as follows:

Type of inputs		High level Fast inputs with common point
Nature of inputs		Voltage / Current (250 Ω internally protected resistors)
Number of channels		8
Acquisition cycle time:		
• Fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• Default (periodic acquisition for all channels)		9 ms
Display resolution		16-bit
Digital filtering		1^{st} order
Isolation:		
• Between channels		Non-isolated
• Between channels and bus		1400 VDC
• Between channels and ground		1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 30 mA
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.55 W
	Maximum	1.01 W

Measurement Range

The BMX AMI 0800 and BMX AMI 0800H *(see page 45)* analog inputs have the following measurement range characteristics:

Measurement range	**+/-10 V; +/-5 V; 0..10 V; 0..5 V; 1..5 V**	**+/-20 mA; 0..20 mA; 4..20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.36 mV	1.4 µA
Input impedance	10 MΩ	250 Ω Internal conversion resistor
Precision of the internal conversion resistor	-	0.1% - 15 ppm/° C
Measurement errors for standard module:		
• At 25° C • Maximum in the temperature range 0...60° C (32...140° F)	0.075% of FS (1) 0.1% of FS (1)	Typically 0.15% of FS (1)(2) 0.3% of FS (1)(2)
Measurement errors for Hardened module:		
• At 25° C • Maximum in the temperature range -25...70° C (-13...158° F)	0.075% of FS (1) 0.2% of FS (1)	Typically 0.15% of FS (1)(2) 0.55% of FS (1)(2)
Legend: (1) FS: Full Scale (2) With conversion resistor error		

Measurement range	**+/-10 V; +/-5 V; 0..10 V; 0..5 V; 1..5 V**	**+/-20 mA; 0..20 mA; 4..20 mA**
Temperature drift	30 ppm/° C	50 ppm/° C including conversion resistance
Monotonicity	Yes	Yes
Crosstalk between channels DC and AC 50/60Hz	> 80dB	> 80dB
Non-linearity	0.001%	0.001%
Repeatability @25° C of 10 min. stabilization time	0.005% of FS	0.007% of FS
Long term stability after 1000 hours	< 0.004% of FS	< 0.004% of FS
Legend: (1) FS: Full Scale (2) With conversion resistor error		

NOTE: If nothing is connected on a BMX AMI 0800 and BMX AMI 0800H *(see page 45)* analog module and if channels are configured (range of 4..20 mA or 1..5 V), there is a detected I/O error as if a wire is broken.

Functional Description

Function

The BMX AMI 0800 module is a high density input analog module with 8 non-input channel.

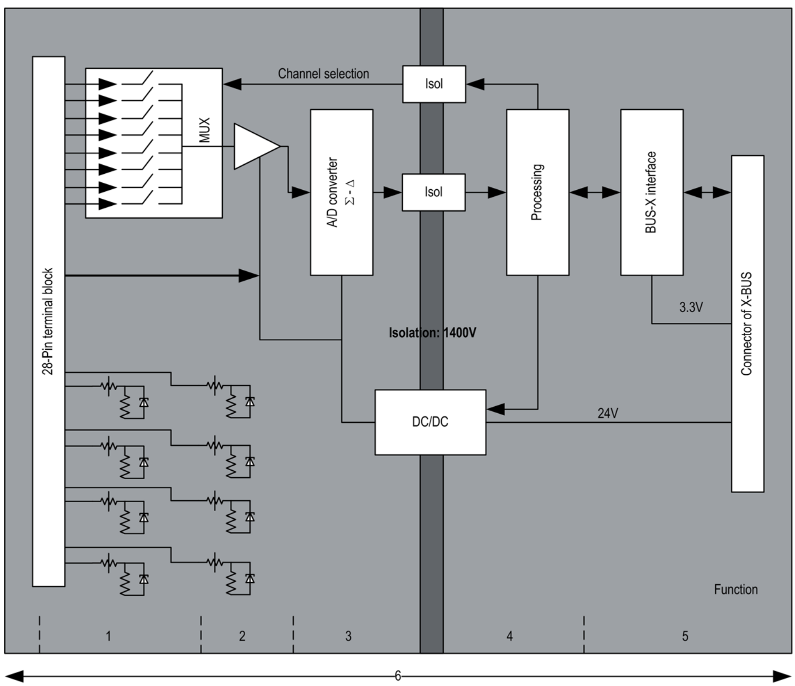
This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

The BMX AMI 0800 module offers the following range for each input according to the selection made during configuration:
- +/-10 V
- 0..10 V
- 0..5 V / 0..20 mA
- 1..5 V / 4..20 mA
- +/-5 V / +/-20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0800 module's illustration:



Description:

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 28-pin screw terminal block • Protection of the module against overvoltages • Input signal analog filtering
2	**Amplifying Input Signals**	• Gain selecting, based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current) • Compensation of drift in amplifier device
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a $\Sigma\Delta$ converter
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients • (Numeric) filtering for measurements, based on configuration parameters • Scaling of measurements, based on configuration parameters
5	**Communicating with the Application**	• Manages exchanges with CPU • Topological addressing • Receives configuration parameters from module and channels • Sends measured values, as well as module status, to application
6	**Module monitoring and sending error notification back to application.**	Conversion string test Testing for range overflow on channels Watchdog test

Measurement Timing

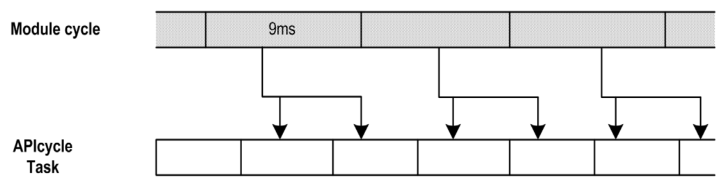
The timing of measurements is determined by the cycle selected during configuration (Normal or Fast Cycle):

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels In Use.

The cycle time values are based on the cycle selected:

Module	Normal Cycle	Fast Cycle
BMX AMI 0800	9 ms	1 ms + (1 ms x N) where N: number of channels in use.

NOTE: Module cycle is not synchronized with the PLC cycle. At the beginning of each PLC cycle, each channel value is taken into account. If the MAST/FAST task cycle time is less than the module's cycle time, some values will not have changed.

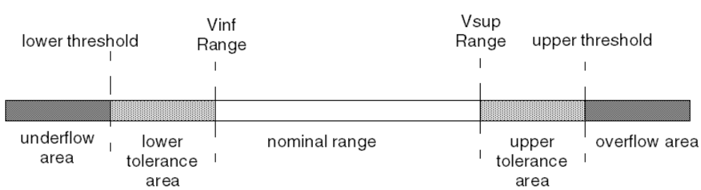


Overflow/Underflow Control

Module BMX AMI 0800 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected the module checks for overflow, it verifies that the measurement falls between a lower and an upper threshold:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Upper Tolerance Area	varies between the values included between the maximum value for the range (for instance: +10 V for the +/-10 V range) and the upper threshold
Lower Tolerance Area	varies between the values included between the minimum value for the range (for instance: -10 V for the +/-10 V range) and the lower threshold
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits:

Range	**BMX AMI 0800 Range**									
	Underflow Area		**Lower Tolerance Area**		**Nominal Range**		**Upper Tolerance Area**		**Overflow Area**	
Unipolar										
0...10 V	-1,500	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,500	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places):

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0% (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00%).

The lower and upper thresholds must be integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

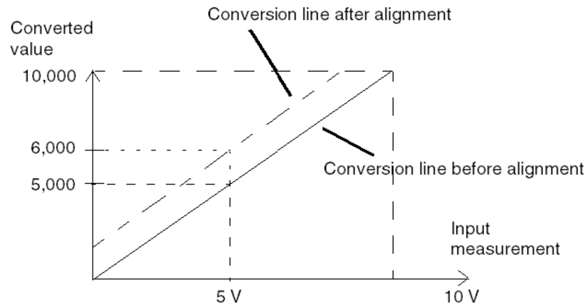
The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.0025 / T 0.0012 / T

Sensor Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Replacing a module does not therefore require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- view and modify the desired measurement value
- save the alignment value
- determine whether the channel already has an alignment

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in standard operating mode, without any effect on the channel's operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1.500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

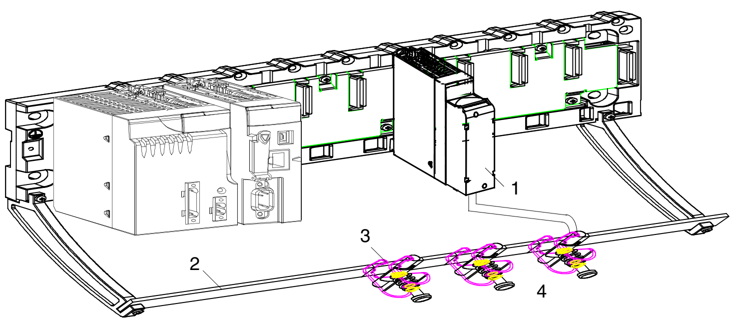
Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

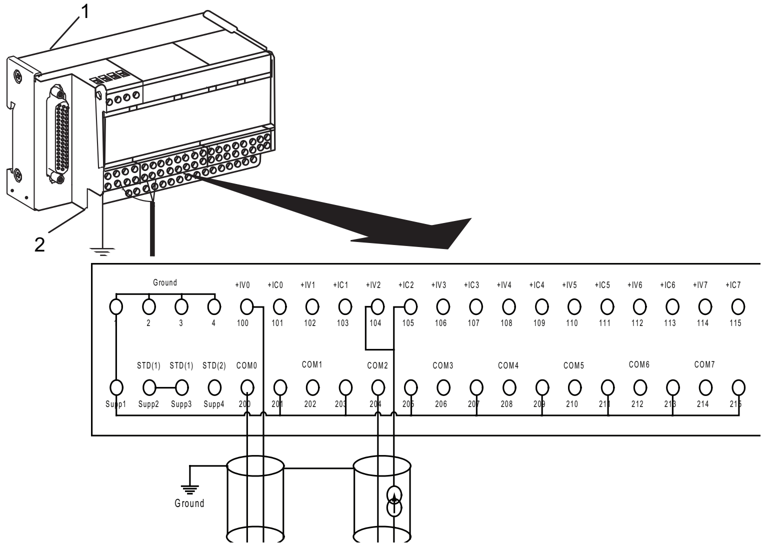
Failure to follow these instructions will result in death or serious injury.



1 BMX AMI 0800
2 Shield bar
3 Clamp
4 To sensors

Example of TELEFAST Connection

Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



1 Telefast ABE-7CPA02
2 The grounding of cables is facilited using the ABE-7BV10 accessory
3 Shield wiring to the ground
4 To voltage sensors
5 To current sensors

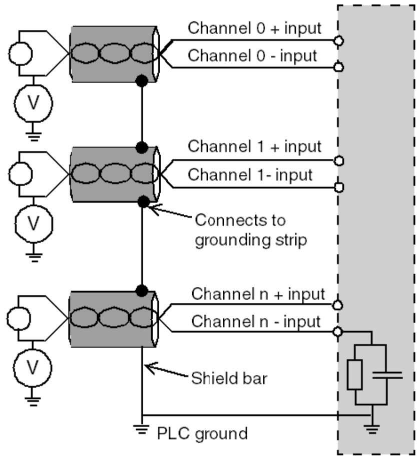
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, It is recommended to take in account the following precautions:

- sensors must be close together (a few meters)
- all sensors must be referenced to a single point, which is connected to the PLC's ground

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in the following diagram:



If the sensors are referenced in relation to the ground, this may in some cases return a remote ground potential to the terminal block. It is therefore **essential** to follow the following rules:

- The potential must be less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground.

Ensure that:

- potentials greater than permitted low limits cannot exist,
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations:

- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

Electromagnetic perturbations may lead to an unexpected behavior of the application.

Failure to follow these instructions can result in injury or equipment damage.

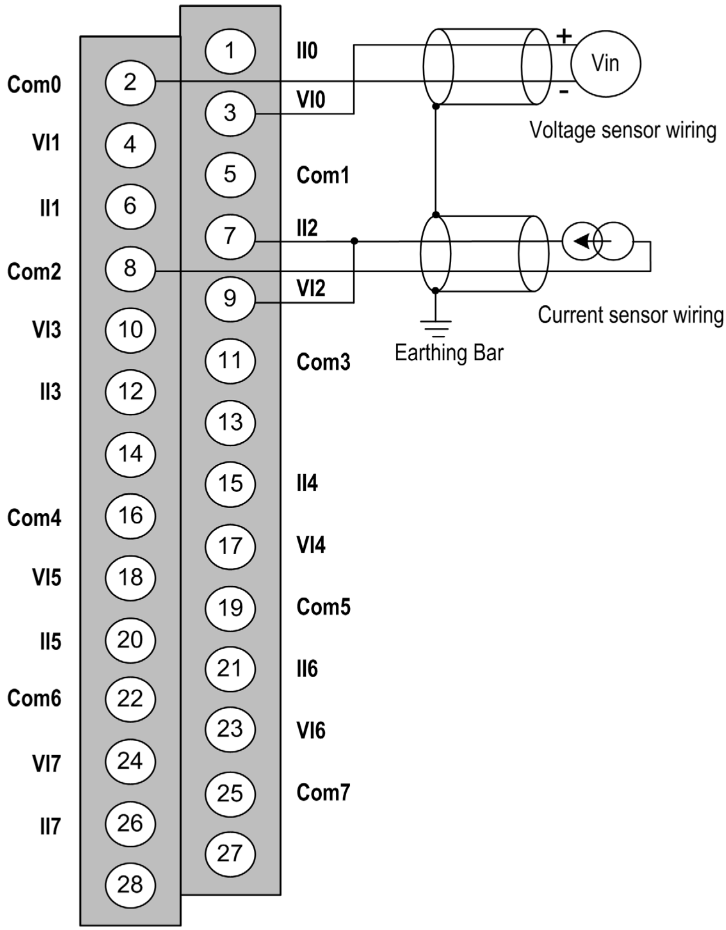
Wiring Diagram

Introduction

Module BMX AMI 0800 is connected using the 28-pin terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows:



VIx + pole input for channel x.
COMx - pole input for channel x, COMx are connected together internally.
IIx current reading resistor + input.
Channel 0 voltage sensor.
Channel 1 2-wire current sensor.

Wiring Accessories

Two cords BMXFTA150 (1.5 m (4.92 ft)) and BMXFTA300 (3 m (9.84 ft)) are provided to connect the module with Telefast interfaces ABE-7CPA02 *(see page 89)*, ABE-7CPA03 *(see page 89)* or ABE-7CPA31 *(see page 89)*.

In case HART information is part of the signal to be measured, a Telefast interface ABE-7CPA31E *(see page 89)* has to be used in order to filter this information that would disrupt the analog value.

⚠ WARNING
EQUIPMENT DAMAGE Do not apply the range of +/-20mA when BMX AMI 0800 works with ABE-7CPA03 *(see page 89)*. The negative current is not supported by ABE-7CPA03 *(see page 89)*. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Use of the TELEFAST ABE-7CPA02/03/31E Wiring Accessory

Introduction

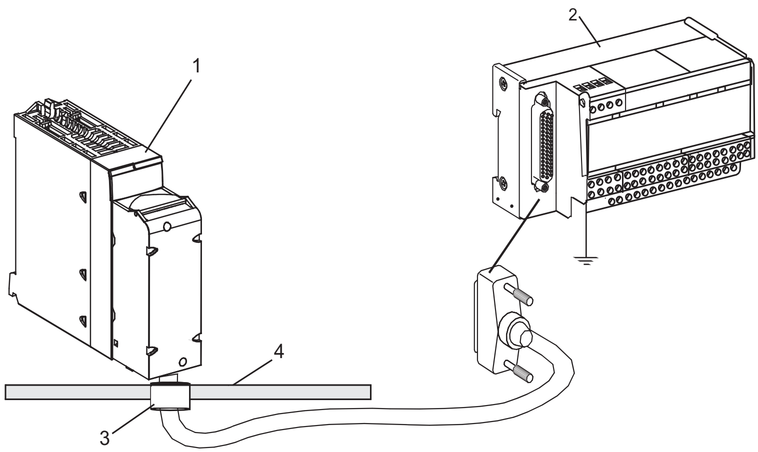
The BMX AMI 0800 module can be connected to a TELEFAST ABE-7CPA02/03/31E accessory.

The module is connected using one of the following cables:

- BMX FTA 150: length 1.5 m (4.92 ft)
- BMX FTA 300: length 3 m (9.84 ft)

Connecting Modules

Modules can be connected to a TELEFAST ABE-7CPA02/03/31E as shown in the diagram below:



1 BMX AMI 0800
2 Telefast ABE-7CPA02/03/31E
3 Clamp
4 Shield bar

NOTICE
EQUIPMENT DAMAGE
Do not apply a negative current when BMXAMI0800 is associated with ABE7CPA03.
Failure to follow these instructions can result in equipment damage.

Connecting Sensors

Sensors may be connected to the ABE-7CPA02/03/31E accessory as shown in the illustration *(see page 87)*.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02:

TELEFAST 2 terminal block number	**25 pin SubD connector pin number**	**AMI08x0 pin out**	**Signal type**	**TELEFAST 2 terminal block number**	**25 pin SubD connector pin number**	**AMI08x0 pin out**	**Signal type**
1	/		Ground	Supp 1	/		Ground
2	/		STD (1)	Supp 2	/		Ground
3	/		STD (1)	Supp 3	/		Ground
4	/		STD (2)	Supp 4	/		Ground
100	1	3	+IV0	200	14	2	COM0
101	2	1	+IC0	201	/		Ground
102	15	4	+IV1	202	3	5	COM1
103	16	6	+IC1	203	/		Ground
104	4	9	+IV2	204	17	8	COM2
105	5	7	+IC2	205	/		Ground
106	18	10	+IV3	206	6	11	COM3
107	19	12	+IC3	207	/		Ground
108	7	17	+IV4	208	20	16	COM4
109	8	15	+IC4	209	/		Ground
110	21	18	+IV5	210	9	19	COM5
111	22	20	+IC5	211	/		Ground
112	10	23	+IV6	212	23	22	COM6
113	11	21	+IC6	213	/		Ground
114	24	24	+IV7	214	12	25	COM7
115	25	26	+IC7	215	/		Ground
+IVx: + pole voltage input for channel x +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x							

NOTE: The strap with the ABE7CPA02 must be removed from the terminal, otherwise the signal ground of the channels will be shorted to the earth.

For the ground connection use the additional terminal block ABE-7BV20.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA03:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMI0800 pin out	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMI0800 pin out	Signal type
1	/		0 V	Supp 1	/		24 V (sensor supply)
2	/		0 V	Supp 2	/		24 V (sensor supply)
3	/		0 V	Supp 3	/		0 V (sensor supply)
4	/		0 V	Supp 4	/		0 V (sensor supply)
100	/		+IS1	200	/		+IS0
101	15	4	+IV1	201	1	3	+IV0
102	16	6	+IC1	202	2	1	+IC0
103	/		Ground	203	14/3	2/5	COM0/COM1
104	/		+IS3	204	/		+IS2
105	18	10	+IV3	205	4	9	+IV2
106	19	12	+IC3	206	5	7	+IC2
107	/		Ground	207	17/6	8/11	COM2/COM3
108	/		+IS5	208	/		+IS4
109	21	18	+IV5	209	7	17	+IV4
110	22	20	+IC5	210	8	15	+IC4
111	/		Ground	211	20/9	16/19	COM4/COM5
112	/		+IS7	212	/		+IS6
113	24	24	+IV7	213	10	21	+IV6
114	25	26	+IC7	214	11	23	+IC6
115	/		Ground	215	23/12	22/25	COM6/COM7
+ISx: 24 V channel power supply +IVx: + pole voltage input for channel x +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x							

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA31E:

TELEFAST 2 terminal block number	Terminal	Signal type	TELEFAST 2 terminal block number	Terminal	Signal type
1	/	Ground	Supp 1	/	24 V (sensor supply)
2	/	Ground	Supp 2	/	24 V (sensor supply)
3	/	Ground	Supp 3	/	0 V (sensor supply)
4	/	Ground	Supp 4	/	0 V (sensor supply)
100	/	+IS0	116	/	+IS4
101	/	T0	117	/	T4
102	/	+IC0	118	/	+IC4
103	/	0V0	119	/	0V4
104	/	+IS1	120	/	+IS5
105	/	T1	121	/	T5
106	/	+IC1	122	/	+IC5
107	/	0V1	123	/	0V5
108	/	+IS2	124	/	+IS6
109	/	T2	125	/	T6
110	/	+IC2	126	/	+IC6
111	/	0V2	127	/	0V6
112	/	+IS3	128	/	+IS7
113	/	T3	129	/	T7
114	/	+IC3	130	/	+IC7
115	/	0V3	131	/	0V7
+ISx: 24 V channel power supply Tx: Reserved test pin for HART function, it’s internally connected with +ICx +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x					

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

BMX AMI 0810 Analog Input Module

5

Subject of this Chapter

This chapter presents the BMX AMI 0810 module, its characteristics, and explains how it is connected to the various sensors.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

The BMX AMI 0810 is a high density input analog module with 8 isolated channels.

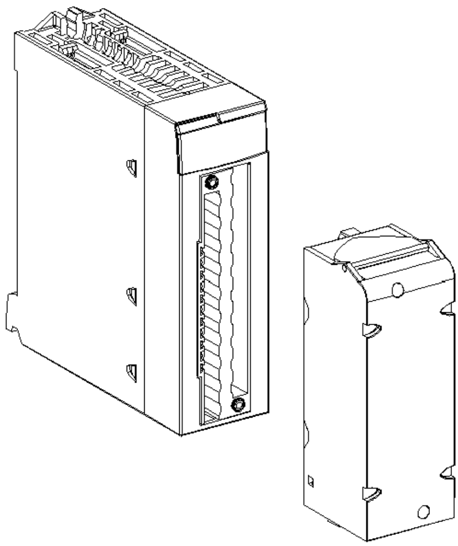
This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

The BMX AMI 0810 module offers the following range for each input according to the selection made during configuration:
- Voltage +/-5 V/+/-10 V/0..5 V/0..10 V/1..5 V
- Current +/-20 mA/0..20 mA/4..20 mA

The module operates with voltage inputs. It includes four read resistors connected to the terminal block to perform current inputs.

Illustration

The following graphic shows the BMX AMI 0810 analog input module:



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMI 0810 and BMX AMI 0810H *(see page 45)* modules are as follows:

Type of inputs		High level isolated fast inputs
Nature of inputs		Voltage / Current (250 Ω internally protected resistors)
Number of channels		8
Acquisition cycle time:		
• Fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• Default (periodic acquisition for all channels)		9 ms
Display resolution		16-bit
Digital filtering		1^{st} order
Isolation:		
• Between channels		+/-300 VDC
• Between channels and bus		1400 VDC
• Between channels and ground		1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 30 mA Protected against accidental wiring: -19.2 to 30VDC **NOTE:** The **Protected for accidental wiring** function is not supported when the module works with any Telefast interface.
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.82 W
	Maximum	1.30 W

Measurement Range

The BMX AMI 0810 and BMX AMI 0810H *(see page 45)* analog inputs have the following measurement range characteristics:

Measurement range	**+/-10 V; +/-5 V; 0..10 V; 0..5 V; 1..5 V**	**+/-20 mA; 0..20 mA; 4..20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.36 mV	1.4 µA
Input impedance	10 MΩ	250 Ω Internal conversion resistor
Precision of the internal conversion resistor	-	0.1% - 15 ppm/°C
Measurement errors for standard module:		
• At 25°C • Maximum in the temperature range 0...60°C (32...140°F)	0.075% of FS (1) 0.1% of FS (1)	Typically 0.15% of FS (1)(2) 0.3% of FS (1)(2)
Measurement errors for Hardened module:		
• At 25°C • Maximum in the temperature range -25...70°C (-13...158°F)	0.075% of FS (1) 0.2% of FS (1)	Typically 0.15% of FS (1)(2) 0.55% of FS (1)(2)
Temperature drift	30 ppm/°C	50 ppm/°C
Monotonicity	Yes	Yes
Crosstalk between channels DC and AC 50/60Hz	> 80dB	> 80dB
Non-linearity	0.001%	0.001%
Repeatability @25°C of 10 min. stabilization time	0.005% of FS	0.007% of FS
Long term stability after 1000 hours	< 0.004% of FS	< 0.004% of FS
Legend: (1) FS: Full Scale (2) With conversion resistor error		

NOTE: If nothing is connected on a BMX AMI 0810 and BMX AMI 0810H *(see page 45)* analog module and if channels are configured (range 4..20 mA or 1..5 V), there is a detected I/O error as if a wire is broken.

Functional Description

Function

The BMX AMI 0810 is a high density input analog module with 8 isolated channels.

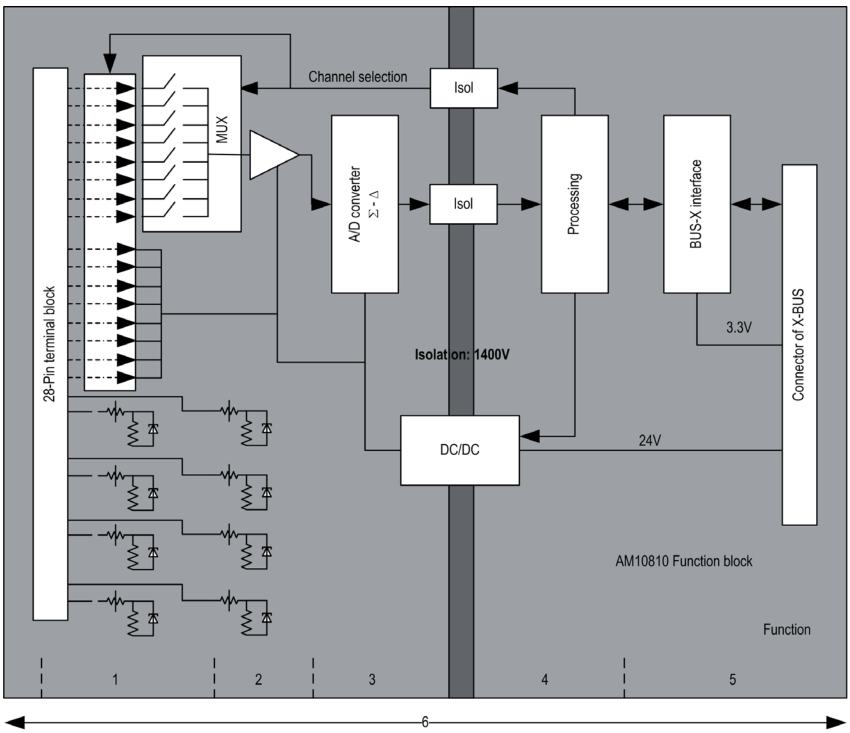
This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

The BMX AMI 0810 module offers the following range for each input according to the selection made during configuration:
- +/-10 V
- 0..10 V
- 0..5 V / 0..20 mA
- 1..5 V / 4..20 mA
- +/-5 V / +/-20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0810 module's illustration:



Description:

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 28-pin screw terminal block • Protection of the module against overvoltages • Protection of the current reading resistors using limiters and resettable fuses • Input signal analog filtering • Scan input channels using static multiplexing through opto-switches, in order to provide the possibility of common mode voltage of +/- 300 Vdc
2	**Amplifying Input Signals**	• Gain selecting , based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current) • Compensation of drift in amplifier device
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a $\Sigma\Delta$ converter
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration and alignment coefficients to be applied to measurements and the module's self-calibration coefficients • (Numeric) filtering fo measurements, based on configuration parameters • Scaling of measurements, based on configuration parameters
5	**Communicating with the Application**	• Manages exchanges with CPU • Topological addressing • Receives configuration parameters from module and channels • Sends measured values, as well as module status, to application
6	**Module monitoring and sending error notification back to application.**	Conversion string test Testing for range overflow on channels Watchdog test

Measurement Timing

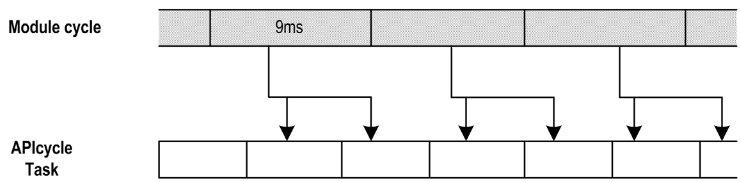
The timing of measurements is determined by the cycle selected during configuration (Normal or Fast Cycle):

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels In Use.

The cycle time values are based on the cycle selected:

Module	Normal Cycle	Fast Cycle
BMX AMI 0810	9 ms	1 ms + (1 ms x N) where N: number of channels in use.

NOTE: Module cycle is not synchronized with the PLC cycle. At the beginning of each PLC cycle, each channel value is taken into account. If the MAST/FAST task cycle time is less than the module's cycle time, some values will not have changed.

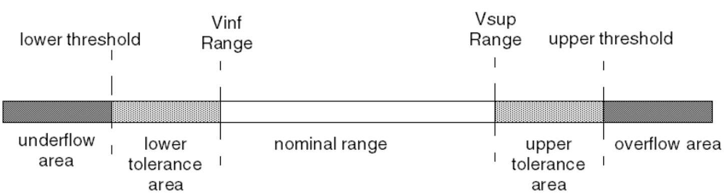


Overflow/Underflow Control

Module BMX AMI 0810 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected the module checks for overflow, it verifies that the measurement falls between a lower and an upper threshold:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Upper Tolerance Area	varies between the values included between the maximum value for the range (for instance: +10 V for the +/-10 V range) and the upper threshold
Lower Tolerance Area	varies between the values included between the minimum value for the range (for instance: -10 V for the +/-10 V range) and the lower threshold
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits:

Range	**BMX AMI 0810 Range**									
	Underflow Area		**Lower Tolerance Area**		**Nominal Range**		**Upper Tolerance Area**		**Overflow Area**	
Unipolar										
0...10 V	-1,500	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,500	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places):

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:
- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

The lower and upper thresholds must be integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

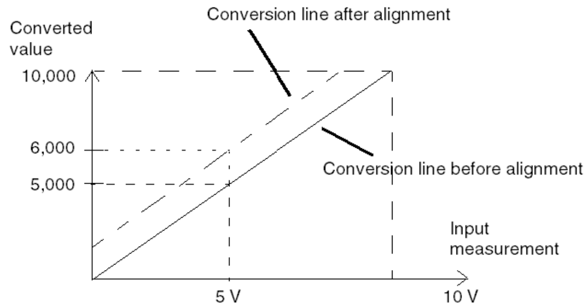
The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.0025 / T 0.0012 / T

Sensor Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Replacing a module does not therefore require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- view and modify the desired measurement value
- save the alignment value
- determine whether the channel already has an alignment

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in standard operating mode, without any effect on the channel's operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1.500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

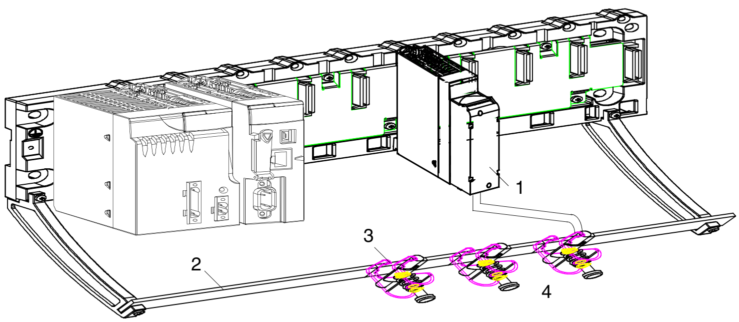
Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

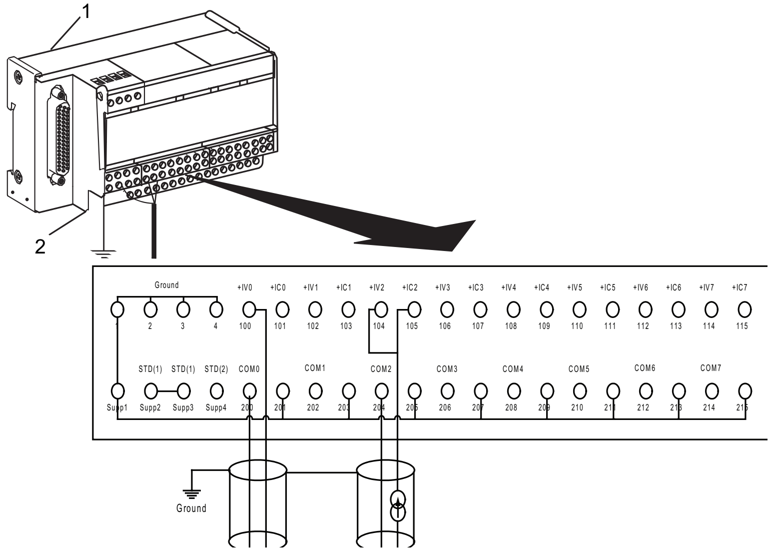
Failure to follow these instructions will result in death or serious injury.



1 BMX AMI 0810
2 Shield bar
3 Clamp
4 To sensors

Example of TELEFAST Connection

Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



1 Telefast ABE-7CPA02
2 The grounding of cables is facilited using the ABE-7BV10 accessory
3 Shield wiring to the ground
4 To voltage sensors
5 To current sensors

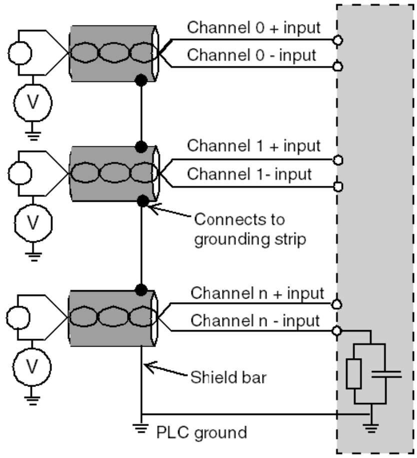
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, it is recommended to take in account the following precautions:

- sensors must be close together (a few meters)
- all sensors must be referenced to a single point, which is connected to the PLC's ground

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in the following diagram:



If the sensors are referenced in relation to the ground, this may in some cases return a remote ground potential to the terminal block. It is therefore **essential** to follow the following rules:

- The potential must be less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

CAUTION
UNEXPECTED BEHAVIOR OF APPLICATION Follow those instructions to reduce electromagnetic perturbations: ● use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding. Electromagnetic perturbations may lead to an unexpected behavior of the application. **Failure to follow these instructions can result in injury or equipment damage.**

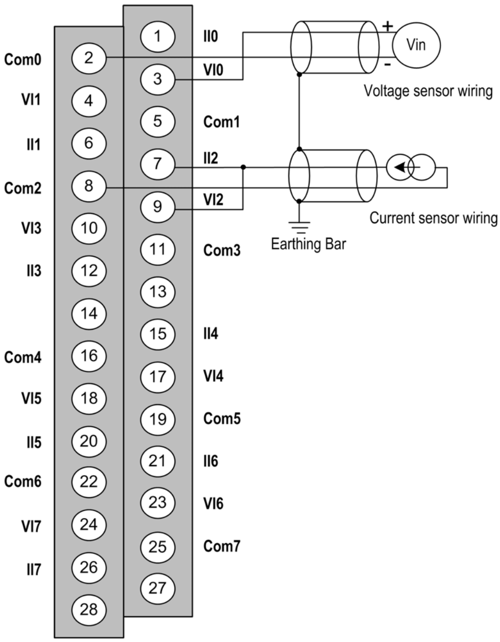
Wiring Diagram

Introduction

Module BMX AMI 0810 is connected using the 28-pin terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows:



VIx + pole input for channel x
COM x - pole input for channel x
IIx current reading resistor + input
Channel 0 voltage sensor
Channel 1 2-wire current sensor

Wiring Accessories

Two cords BMXFTA150 (1.5 m (4.92 ft)) and BMXFTA300 (3 m (9.84 ft)) are provided to connect the module with Telefast interfaces ABE-7CPA02 *(see page 89)*, ABE-7CPA31 *(see page 89)* or ABE-7CPA31E *(see page 89)*.

In case HART information is part of the signal to be measured, a Telefast interface ABE-7CPA31E *(see page 89)* has to be used in order to filter this information that would disrupt the analog value.

Use of the TELEFAST ABE-7CPA02/31/31E Wiring Accessory

Introduction

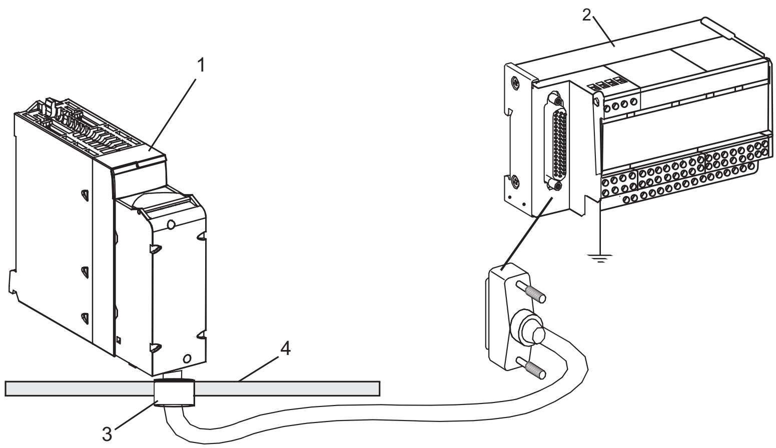
The BMX AMI 0810 module can be connected to a TELEFAST ABE-7CPA02/31/31E accessory.

The module is connected using one of the following cables:

- BMX FTA 150: length 1.5 m (4.92 ft)
- BMX FTA 300: length 3 m (9.84 ft)

Connecting Modules

Modules can be connected to a TELEFAST ABE-7CPA02/31/31E as shown in the diagram below:



1 BMX AMI 0810
2 Telefast ABE-7CPA02/31/31E
3 Clamp
4 Shield bar

Connecting Sensors

Sensors may be connected to the ABE-7CPA02/31/31E accessory as shown in the illustration *(see page 87)*.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02:

TELEFAST 2 terminal block number	**25 pin SubD connector pin number**	**AMI08x0 pin out**	**Signal type**	**TELEFAST 2 terminal block number**	**25 pin SubD connector pin number**	**AMI08x0 pin out**	**Signal type**
1	/		Ground	Supp 1	/		Ground
2	/		STD (1)	Supp 2	/		Ground
3	/		STD (1)	Supp 3	/		Ground
4	/		STD (2)	Supp 4	/		Ground
100	1	3	+IV0	200	14	2	COM0
101	2	1	+IC0	201	/		Ground
102	15	4	+IV1	202	3	5	COM1
103	16	6	+IC1	203	/		Ground
104	4	9	+IV2	204	17	8	COM2
105	5	7	+IC2	205	/		Ground
106	18	10	+IV3	206	6	11	COM3
107	19	12	+IC3	207	/		Ground
108	7	17	+IV4	208	20	16	COM4
109	8	15	+IC4	209	/		Ground
110	21	18	+IV5	210	9	19	COM5
111	22	20	+IC5	211	/		Ground
112	10	23	+IV6	212	23	22	COM6
113	11	21	+IC6	213	/		Ground
114	24	24	+IV7	214	12	25	COM7
115	25	26	+IC7	215	/		Ground
+IVx: + pole voltage input for channel x +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x							

NOTE: The strap with the ABE7CPA02 must be removed from the terminal, otherwise the signal ground of the channel 0 will be shorted to the earth.

For the ground connection use the additional terminal block ABE-7BV20.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA31:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMI0810 pin out	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMI0810 pin out	Signal type
1	/		Ground	Supp 1	/		24 V (sensor supply)
2	/		Ground	Supp 2	/		24 V (sensor supply)
3	/		Ground	Supp 3	/		0 V (sensor supply)
4	/		Ground	Supp 4	/		0 V (sensor supply)
100	/		+IS0	116	/		+IS4
101	1	3	+IV0	117	7	17	+IV4
102	2	1	+IC0	118	8	15	+IC4
103	14	2	0 V	119	20	16	0 V
104	/		+IS1	120	/		+IS5
105	15	4	+IV1	121	21	18	+IV5
106	16	6	+IC1	122	22	20	+IC5
107	3	5	0 V	123	9	19	0 V
108	/		+IS2	124	/		+IS6
109	4	9	+IV2	125	10	23	+IV6
110	5	7	+IC2	126	11	21	+IC6
111	17	8	0 V	127	23	22	0 V
112	/		+IS3	128	/		+IS7
113	18	10	+IV3	129	24	24	+IV7
114	19	12	+IC3	130	25	26	+IC7
115	6	11	0 V	131	12	25	0 V
+ISx: 24 V channel power supply +IVx: + pole voltage input for channel x +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x							

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA31E:

TELEFAST 2 terminal block number	Terminal	Signal type	TELEFAST 2 terminal block number	Terminal	Signal type
1	/	Ground	Supp 1	/	24 V (sensor supply)
2	/	Ground	Supp 2	/	24 V (sensor supply)
3	/	Ground	Supp 3	/	0 V (sensor supply)
4	/	Ground	Supp 4	/	0 V (sensor supply)
100	/	+IS0	116	/	+IS4
101	/	T0	117	/	T4
102	/	+IC0	118	/	+IC4
103	/	0V0	119	/	0V4
104	/	+IS1	120	/	+IS5
105	/	T1	121	/	T5
106	/	+IC1	122	/	+IC5
107	/	0V1	123	/	0V5
108	/	+IS2	124	/	+IS6
109	/	T2	125	/	T6
110	/	+IC2	126	/	+IC6
111	/	0V2	127	/	0V6
112	/	+IS3	128	/	+IS7
113	/	T3	129	/	T7
114	/	+IC3	130	/	+IC7
115	/	0V3	131	/	0V7
+ISx: 24 V channel power supply Tx: Reserved test pin for HART function, it’s internally connected with +ICx +ICx: + pole current input for channel x COMx: - pole voltage or current input for channel x					

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

BMX ART 0414/0814 Analog Input Modules

6

Subject of this Chapter

This chapter presents the BMX ART 0414/0814 modules, their characteristics and explains how they are connected to the various sensors.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

The BMX ART 0414/0814 modules are multi-range acquisition devices with four inputs for the 0414 and eight inputs for the 0814. The inputs are isolated from each other. These modules offer the following ranges for each input, according to the selection made at configuration:

- RTD IEC Pt100/Pt1000, US/JIS Pt100/Pt1000, Cu10, Ni100/Ni1000 in 2, 3 or 4 wires
- thermocouple B, E, J, K, L, N, R, S, T, U
- voltage +/- 40 mV to 1.28 V.

Presentation

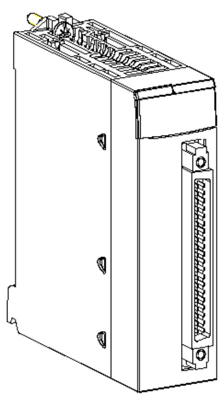
These modules offer the following ranges for each input, according to the selection made at configuration:

- Cu50 6651-94, Cu100 6651-94 in 2, 3 or 4 wires

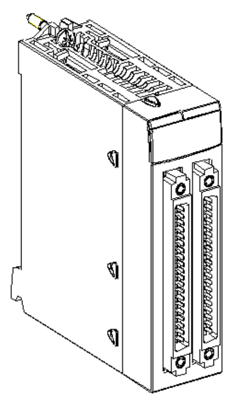
Illustration

The BMX ART 0414/0814 analog input modules looks like this:

BMX ART 0414



BMX ART 0814



Characteristics

General Characteristics

The general characteristics for the BMX ART 0414/BMX ART 0414H *(see page 45)* and BMX ART 0814/BMX ART 0814H *(see page 45)* modules are as follows:

Modules		**ART 0414**	**ART 0814**
Type of inputs		Isolated, RTD, thermocouple and voltage inputs	
Nature of inputs		+/- 40 mV; +/- 80 mV; +/- 160 mV; +/- 320 mV; +/- 640 mV; 1.28 V	
Number of channels		4	8
Acquisition cycle time		400 ms / 4 channels	400 ms / 8 channels
Conversion method		ΣΔ	
Resolution		15-bit + sign	
Isolation:			
• **Between channels** • **Between channels and bus** • **Between channels and ground**		750 Vdc 1400 Vdc 750 Vdc	
Maximum authorized over voltage for inputs		+/- 7.5 Vdc	
Cold junction compensation		• Internal compensation using the dedicated TELEFAST ABE-7CPA412 wiring accessory, including a sensor. • External compensation dedicating channel 0 to a 2/3-wires Pt100 for CJC. • External compensation using the CJC values of channels 4/7 for channels 0/3. In this case, only one sensor is needed.	
Input filter		Low pass filter (1st order numerical)	
Rejection in differential mode (50/60 Hz)		Typically 60 dB	
Common mode rejection (50/60 Hz)		Typically 120 dB	
Power consumption (3.3 V)	**Typical**	0.32 W	0.32 W
	Maximum	0.48 W	0.48 W
Power consumption (24 V)	**Typical**	0.47 W	1.00 W
	Maximum	1.20 W	1.65 W

Voltage Input Characteristics

The characteristics of the voltage inputs of the BMX ART 0414/BMX ART 0414H *(see page 45)* and BMX ART 0814/BMX ART 0814H *(see page 45)* modules are as follows:

Voltage range	+/- 40 mV; +/- 80 mV; +/- 160 mV; +/- 320 mV; +/- 640 mV; 1.28 V
Input impedance	Typically 10 MOhms
Maximum converted value	+/- 102.4%
Maximum resolution	2.4 µV in the range +/- 40 mV
Measurement error for standard module	
• **At 25° C (77° F)**	0.05% of FS (1)
• **Maximum in the temperature range 0...60° C (32...140° F)**	0.15% of FS (1)
Measurement error for Hardened module	
• **At 25° C (77° F)**	0.05% of FS (1)
• **Maximum in the temperature range -25° C..70° C (-13...140° F)**	0.20% of FS (1)
Temperature drift	30 ppm/° C
Legend: (1) FS: Full Scale	

RTD Input Characteristics

The characteristics of the RTD inputs of the BMX ART 0414/BMX ART 0414H *(see page 45)* and BMX ART 0814/BMX ART 0814H *(see page 45)* modules are as follows:

RTD	**Pt100**	**Pt1000**	**Cu10**	**Ni100**	**Ni1000**
Measurement range	In accordance with IEC: -175... +825° C (-347...+1517° F) In accordance with US/JIS: -87 +437° C (-125...+819° F)		-91... +251° C (-132 ...+484° F)	-54 +174° C (-65...+345° F)	
Resolution	0.1° C (0.2° F)				
Detection type	Open circuit (detection on each channel)				
Legend (1) Excluding errors caused by the wiring, +/- 1° C (0.2° F) on the range -100...+200° C (-148...+392° F) for Pt100 (2) See detailed errors at the temperature point *(see page 332)*.					

RTD	Pt100	Pt1000	Cu10	Ni100	Ni1000
Error at 25° C (77° F) (1)	+/- 2.1 ° C (+/- 3.8° F)	+/- 2.1 ° C (+/- 3.8° F)	+/- 4 ° C (+/- 7.2° F)	+/- 2.1 ° C (+/- 3.8° F)	+/- 0.7 ° C (+/- 1.3° F)
Maximum error for standard modules in the temperature range 0...60° C (32...140° F) (2)	+/- 3 ° C (+/- 5.4° F)	+/- 3 ° C (+/- 5.4° F)	+/- 4 ° C (+/- 7.2° F)	+/- 3 ° C (+/- 5.4° F)	+/- 1.3 ° C (+/- 2.3° F)
Maximum error for Harened modules in the temperature range -25° C..70° C (-13...140° F) (2)	+/- 3.5 ° C (+/- 6.3° F)	+/- 3.5 ° C (+/- 6.3° F)	+/- 4.5 ° C (+/- 8.1° F)	+/- 3.5 ° C (+/- 6.3° F)	+/- 1.5 ° C (+/- 2.7° F)
Maximum wiring resistance					
• **4-wire**	50 Ohms	500 Ohms	50 Ohms	50 Ohms	500 Ohms
• **2/3-wire**	20 Ohms	200 Ohms	20 Ohms	20 Ohms	200 Ohms
Temperature drift	30 ppm/° C				
Legend					
(1) Excluding errors caused by the wiring, +/- 1° C (0.2° F) on the range -100...+200° C (-148...+392° F) for Pt100					
(2) See detailed errors at the temperature point *(see page 332)*.					

RTD	CU50	CU100
Measurement range	-200...+200° C	
Resolution	0.1° C (0.2° F)	
Detection type	Open circuit (detection on each channel)	
Error at 25° C (77° F) (1)	+/- 2.1° C (+/- 3.8° F)	
Maximum error for standard modules in the temperature range 0...60° C (32...140° F) (2)	+/- 3° C (+/- 5.4° F)	
Maximum error for Hardened modules in the temperature range -25° C..70° C (-13...140° F) (2)	+/- 3.5° C (+/- 6.3° F)	
Maximum wiring resistance: • **4-wire** • **2/3-wire**	 • 50 Ohms • 20 Ohms	
Temperature drift	30 ppm/° C	
Legend		
(1) Excluding errors caused by the wiring, +/- 1° C (0.2° F) on the range -100...+200° C (-148...+392° F) for Pt100		
(2) See detailed errors at the temperature point *(see page 332)*.		

Thermocouple Input Characteristics

This table presents the general characteristics of the thermocouple inputs of the BMX ART 0414/BMX ART 0414H *(see page 45)* and BMX ART 0814/BMX ART 0814H *(see page 45)* modules.

Thermocouples	**B**	**E**	**J**	**K**	**L**
Measurement range	+171 +1,779° C (340...3234° F)	-240 +970° C (-400...1778° F)	-177 +737° C (-287...1359° F)	-231 +1,331° C (-384...2428° F)	-174 +874° C (-281...1605° F)
Thermocouples	**N**	**R**	**S**	**T**	**U**
Measurement range	-232 +1,262° C (-386...2304° F)	-9 +1,727° C (340...3234° F)	-9 +1,727° C (-15...3141° F)	-254 +384° C (-425...723° F)	-181 +581° C (-294...1078° F)
Resolution	0.1° C (0.2° F)				
Detection type	Open circuit (detection on each channel)				
Error at 25° C	+/- 3.2° C for J, L, R, S and U types (see *Characteristics of the BMX ART 0414/814 Thermocouple Ranges in Degrees Celsius, page 334* for detailed errors at temperature point for each type); +/- 3.7° C for B, E, K, N and T types				
Maximum error for standard modules in the temperature range - 25° C..70° C(-13...140° F)(2)	+/- 4.5° C (+/-8.1° F) for types: J, L, R, S and U; +/- 5° C (+/-9° F) for types: B, E, K, N and T (using the TELEFAST accessory with its internal cold junction compensation).				
Maximum error for Hardened modules in the temperature range - 25° C..70° C(-13...140° F)(2)	+/- 5.5° C (+/-9° F) for types: J, L, R, S and U; +/- 6° C (+/-10.8° F) for types: B, E, K, N and T (using the TELEFAST accessory with its internal cold junction compensation).				
Temperature drift	30 ppm/° C				

Resistive Input Characteristics

The characteristics of the resistive inputs of the BMX ART 0414/BMX ART 0414H *(see page 45)* and BMX ART 0814/BMX ART 0814H *(see page 45)* are as follows.

Range	400 Ω; 4000 Ω
Type measurement	2, 3, 4 wires
Maximum resolution	2.5 mΩ in the range 400 Ω 25 mΩ in the range 4000 Ω
Measurement error for standard module	
• **At 25° C (77° F)**	0.12% of FS (1)
• **Maximum in the temperature range 0...60° C (32...140° F)**	0.2% of FS (1)
Measurement error for ruggedized module	
• **At 25° C**	0.12% of FS (1)
• **Maximum in the temperature range -25° C..70° C (-13...140° F)**	0.3% of FS (1)
Temperature drift	25 ppm/° C
Legend: (1) FS: Full Scale	

Analog Input Values

Description

For RTD and TC sensors, the data is a multiple of 10 of the real temperature in °C or °F. The last digit represents 0.1°C or 0.1°F.

For millivoltmeter, the data ranges from 40 mV, 320 mV to 1280 mV and is also a multiple of 10 of the real measurement. The last digit represents 10 nV.

For millivoltmeter, the data range of 640 mV is a multiple of 100 of the real measurement. The last digit represents 100 nV.

RTD Ranges

The table below presents the ranges for the RTD sensors (values in brackets are in 1/10°F).

Range	Under flow	Lower scale	Upper scale	Over flow
Pt100 IEC 751-1995, JIS C1604-1997 (2/4 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)
Pt1000 IEC 751-1995, JIS C1604-1997 (2/4 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)
Ni100 DIN43760-1987 (2/4 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)
Ni1000 DIN43760-1987 (2/4 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)
Pt100 IEC 751-1995, JIS C1604-1997 (3 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)
Pt1000 IEC 751-1995, JIS C1604-1997 (3 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)
Ni100 DIN43760-1987 (3 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)
Ni1000 DIN43760-1987 (3 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)
JPt100 JIS C1604-1981, JIS C1606-1989 (2/4 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)
JPt1000 JIS C1604-1981, JIS C1606-1989 (2/4 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)
JPt100 JIS C1604-1981, JIS C1606-1989 (3 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)

Range	Under flow	Lower scale	Upper scale	Over flow
JPt1000 JIS C1604-1981, JIS C1606-1989 (3 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)
Cu10 (2/4 wires)	-990 (-1460)	-910 (-1320)	2510 (4840)	2590 (4980)
Cu10 (3 wires)	-990 (-1460)	-910 (-1320)	2510 (4840)	2590 (4980)

TC Ranges

The table below presents the ranges for the TC sensors (values in brackets are in (1/10° F).

Range	Under flow	Lower scale	Upper scale	Over flow
Type J	-1980 (-3260)	-1770 (-2870)	7370 (13590)	7580 (13980)
Type K	-2680 (-4500)	-2310 (-3830)	13310 (24270)	13680 (24940)
Type E	-2690 (-4510)	-2400 (-3990)	9700 (17770)	9990 (18290)
Type T	-2690 (-4520)	-2540 (-4250)	3840 (7230)	3990 (7500)
Type S	-500 (-540)	-90 (160)	17270 (29550)	17680 (30250)
Type R	-500 (-540)	-90 (160)	17270 (29550)	17680 (30250)
Type B	1320 (2700)	1710 (3390)	17790 (32000)	18170 (32000)
Type N	-2670 (-4500)	-2320 (-3860)	12620 (23040)	12970 (23680)
Type U	-1990 (-3250)	-1810 (-2930)	5810 (10770)	5990 (11090)
Type L	-1990 (-3250)	-1740 (-2800)	8740 (16040)	8990 (16490)

Voltage Ranges

The table below presents the voltage ranges.

Range	Under flow	Lower scale	Upper scale	Over flow
+/- 40 mV	-4192	-4000	4000	4192
+/- 80 mV	-8384	-8000	8000	8384
+/- 160 mV	-16768	-16000	16000	16768
+/- 320 mV	-32000	-32000	32000	32000
+/- 640 mV	-6707	-6400	6400	6707
+/- 1280 mV	-13414	-12800	12800	13414

Resistance Ranges

The table below presents the resistance ranges.

Range	Under flow	Lower scale	Upper scale	Over flow
0-400 Ohms 2/4 wires	0	0	4000	4096
0-4000 Ohms 2/4 wires	0	0	4000	4096
0-400 Ohms 3 wires	0	0	4000	4096
0-4000 Ohms 3 wires	0	0	4000	4096

Functional Description

Function

The BMX ART 0414/814 modules are multi-range acquisition devices with four inputs for the BMX ART 0414 and eight inputs for the BMX ART 0814.

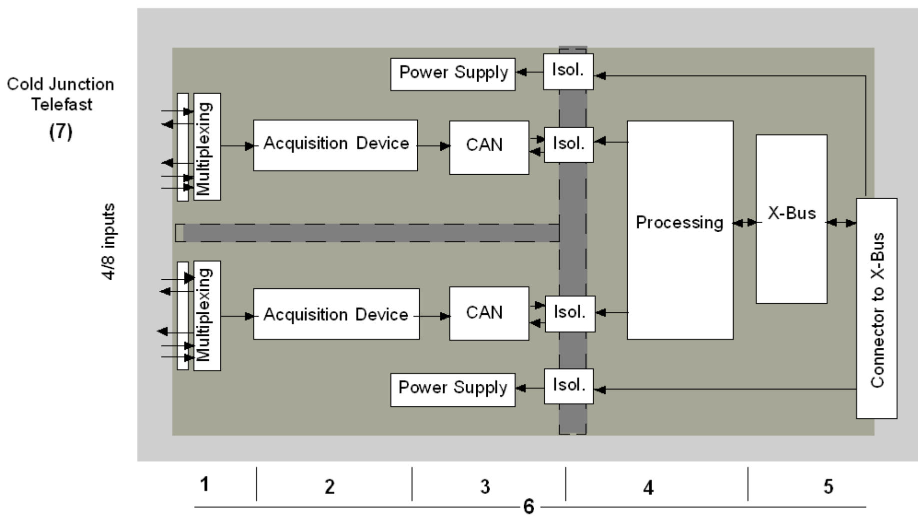
Both Modules offer the following ranges for each input, according to the selection made during configuration:

- RTD: IEC Pt100, IEC Pt1000, US/JIS Pt100, US/JIS Pt1000, Copper CU10, Ni100 or Ni1000
- thermocouple: B, E, J, K, L, N, R, S, T or U,
- voltage: +/- 80 mV, +/- 80 mV, +/- 160 mV, +/- 320 mV, +/- 640 mV, +/- 1.28 V,
- ohms: 0..400 Ω, 0..4000 Ω

NOTE: The TELEFAST2 accessory referenced **ABE-7CPA412** facilitates connection and provides a cold junction compensation device.

Illustration

The BMX ART 0414/0814 input modules perform the following functions.



Details of the functions are as follows.

Address	Element	Function
1	Adapting the Inputs	Adaptation consists in a common mode and ifferential mode filter. Protection resistors on the inputs allowt to withstand voltage spikes of up to +/- 7.5 V. A layer of multiplexing allows self-calibration of the acquisition device offset, as close as possible to the input terminal, as well as selecting the cold junction compensation sensor included in the TELEFAST housing.
2	Amplifying Input Signals	Built around a weak-offset amplifier internal to the A/N converter. A current generator ensures the RTD resistance measurement.
3	Conversion	The converter receives the signal issued from an input channel or from the cold junction compensation. Conversion is based on a $\Sigma\Delta$ 16 -bit converter. There is a converter for each input.
4	Transforming incoming values into workable measurements for the user	• recalibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients • (numeric) filtering of measurements, based on configuration parameters • scaling of measurements, based on configuration parameters
5	Communicating with the Application	• manages exchanges with CPU. • topological addressing • receiving configuration parameters from module and channels • sending measured values, as well as module status, to the application
6	Module monitoring and sending error notification back to application	• conversion string test • range under/overflow on channels and cold junction compensation process test • watchdog test
7	Cold Junction Compensation	• internal compensation using the TELEFAST ABE-7CPA412 • external compensation by Pt100 • external compensation using the CJC values of channels 4/7 for channels 0/3. In this case, only one sensor is needed

Display of Electrical Range Measurements

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Bipolar range	from -10,000 to +10,000 (-100.00 % to +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range -100.00 %
- the upper threshold corresponding to the maximum value for the range +100.00 %

These lower and upper thresholds are integers between -32,768 and 32,768.

Display of Temperature Range Measurements

Measurements provided to the application are directly usable. It is possible to choose either "In Temperature" Display or Standardized Display:

- for "In Temperature" display mode, values are provided in tenths of a degree (Celsius or Fahrenheit, depending on the unit you have selected).
- for the user-specified display, you may choose a Standardized Display 0...10,000 (meaning from 0 to 100.00 %), by specifying the minimum and maximum temperatures as expressed in the 0 to 10,000 range.

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where:

α = efficiency of the filter

Mesf(n) = measurement filtered at moment n

Mesf(n-1) = measurement filtered at moment n-1

Valg(n) = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). **This value may be changed even when the application is in RUN mode**.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

The filtering values are as follows. They depend on the sensor type. T is a cycle time of 200 ms for TC and mV. T is also a cycle time of 400 ms for RTD and Ohms.

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.025 / T 0.012 / T

The values may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar range	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range	from -10,000 to 10,000 (-100.00 % to +100.00 %)

The user may also define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range -100.00 %
- the upper threshold corresponding to the maximum value for the range +100.00 %.

These lower and upper thresholds are integers between -32,768 and +32,767.

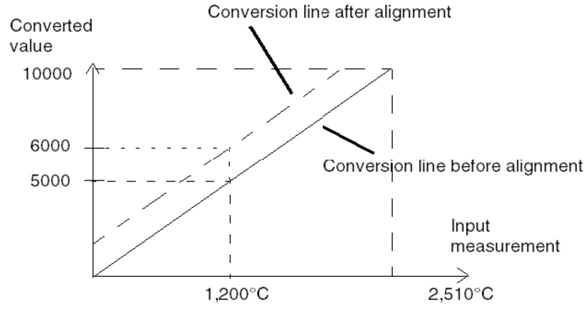
Main frequency 50/60 Hz Rejection

Depending on the country, the user can configure the frequency rejection of main power harmonics by adapting the speed of sigma delta converter.

Sensor Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- view and modify the desired measurement value.
- save the alignment value.
- determine whether the channel already has an alignment.

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in standard operating mode, without any effect on the channel's operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

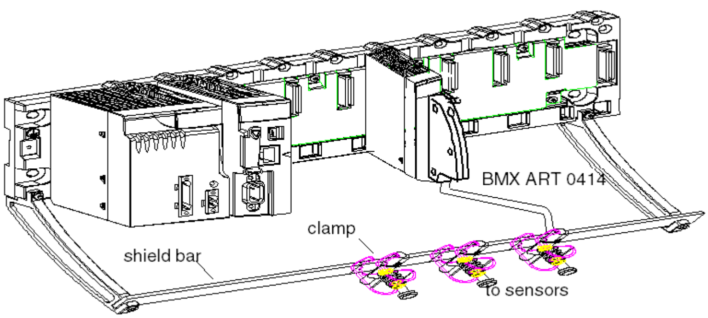
- Connection at the FCN connectors:
  Given that there are a large number of channels, a cable of at least 10 twisted pairs is used, with general shielding (outside diameter 10 mm maximum), fitted with one or two male 40-pin FCN connectors for direct connection to the module. Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

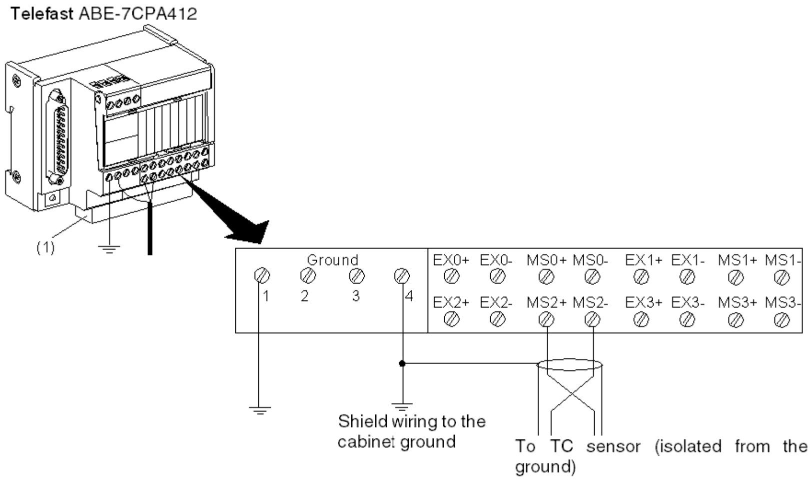
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

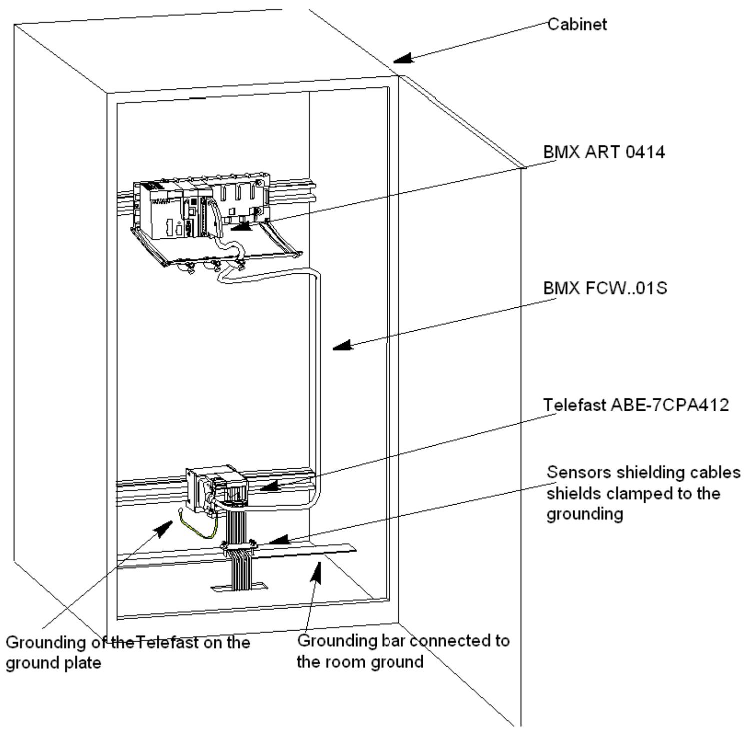
Failure to follow these instructions will result in death or serious injury.



- TELEFAST connection:
  Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



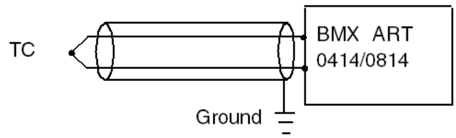
(1) The grounding of cables is facilited using the ABE-7BV10 accessory.



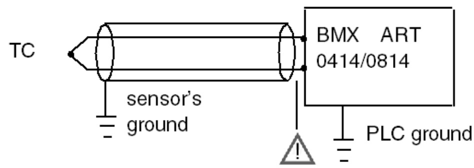
Sensors shielding

In order for the acquisition system to operate correctly, we recommend you take the following precautions:

- if sensors are isolated from ground, all the shields of the sensor cables must be referenced to the Telefast/PLC ground.

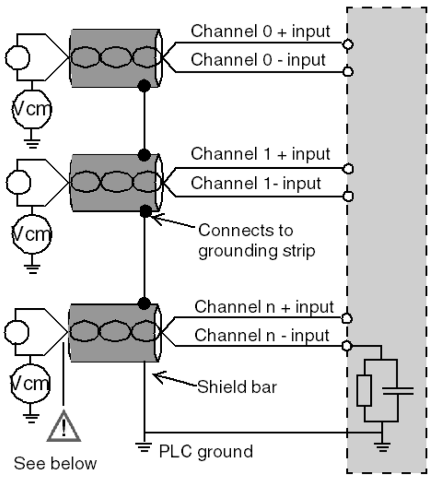


- if sensors are referenced to the sensor ground which is far from PLC ground, all the shields of the sensor cables must be referenced to the sensors ground to eliminate the ground loop path.



Using the Sensors Isolated from the Ground

The sensors are connected according to the following diagram:



If the sensors are referenced in relation to the ground, this may in some cases return a remote ground potential to the terminals or the FCN connector. It is therefore essential to follow the following rules:

- the potential must be less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

⚠ CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations:

- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

Electromagnetic perturbations may lead to an unexpected behavior of the application.

Failure to follow these instructions can result in injury or equipment damage.

Wiring Diagram

Introduction

The BMX ART 0414 input module consists of a 40-pin FCN connector.

The BMX ART 0814 input module consists of two 40-pin FCN connectors.

⚠ WARNING
UNEXPECTED EQUIPMENT OPERATION
Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Connector Pin Assignment and Sensors Wiring

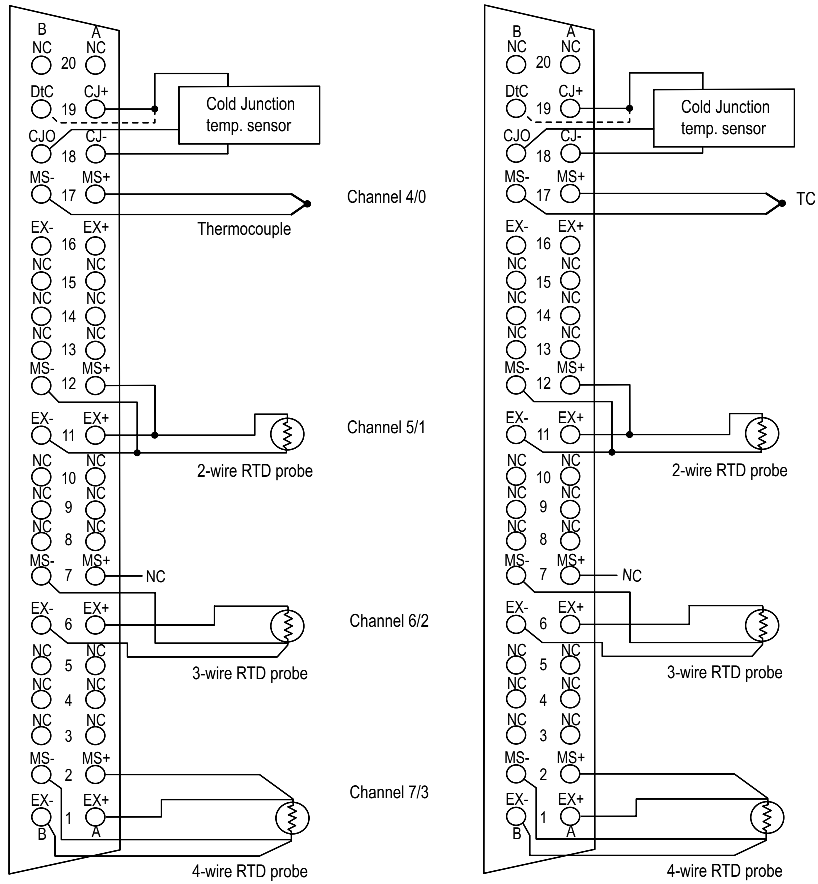
This example uses a probe configuration with:

- Channel 0/4: Thermocouple
- Channel 1/5: 2-wires RTD
- Channel 2/6: 3-wires RTD
- Channel 3/7: 4-wires RTD

The pin assignment for the 40-pin FCN connector and the sensors wiring is shown below:

Module Front View - cabling view

Left connector Right connector (BMX ART 414 only)



MS+: RTD Measure + input / Thermocouple + input
MS-: RTD Measure - input / Thermocouple - input
EX+: RTD probe current generator + output
EX-: RTD probe current generator - output
NC: Not connected
DtC: The CJC sensor detection input is connected to CJ+ if the sensor type is DS600. It is not connected (NC) if the sensor type is LM31.

NOTE: The CJC sensor is needed for TC only.

Cold Junction Compensation

For each block of 4 channels (channels 0 to 3 and channels 4 to 7), the external compensation of the module is performed in the TELEFAST ABE-7CPA412 accessory. This device provides a voltage in mV corresponding to:

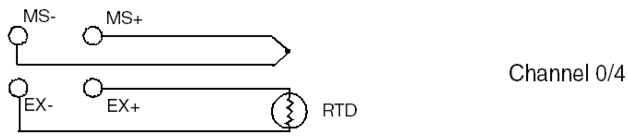
Voltage = (6.45 mV * T) + 509 mV (where T = temperature in °C).

The overall margin of error when using this device is reduced to 1.2° C in the -5° C to +60° C temperature range.

It is possible to increase the precision of the compensation by using a 2/3-wires Pt100 probe directly connected to channels 0 and 4 (only for the BMX ART0814) on the module or connected to the TELEFAST terminal blocks. Channel 0 is thus dedicated to the cold junction compensation of channels 1, 2 and 3. channel 4 is thus dedicated to channels 4 to 7.

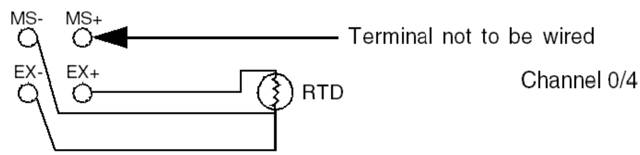
It is also possible, by using a 2-wire Pt100 probe, provided the initial length of the probe is limited, to maintain channel 0 as a thermocouple input.

The wiring would then look like this:



The wiring is only valid if the channel 0 is used. If the channel 0 is not used, select a cold junction with external Pt100. The range of the channel 0 is changed to a 3-wires Pt100 probe.

The wiring would then look like this:



NOTE: For the BMX ART 0814 Module, the CJC values of channels 4 to 7 can also be used for channels 0 to 3. Therefore, only one external CJC *(see page 135)* sensor is wired on channel 4.

Use of the TELEFAST ABE-7CPA412 Accessory

At a Glance

The TELEFAST ABE-7CPA412 accessory is a base unit used to connect 4-channel analog modules to screw terminal blocks.

NOTE: When the cabinet where the TELEFAST ABE-7CPA412 accessory is located and powered up, wait at least 45mn to achieve full precision of the CJC compensation. It is not necessary to wait 45 mn if the compensation is performed by an external Pt100 probe.

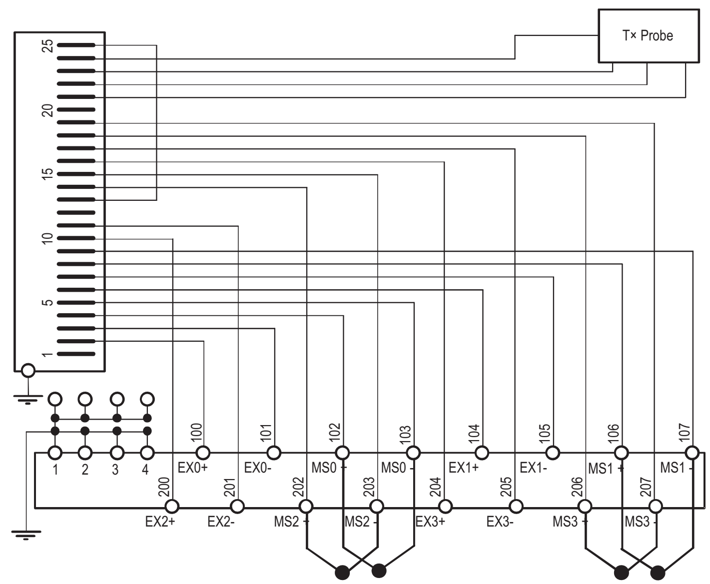
When using the TELEFAST ABE-7CPA412's cold junction compensation, in order to make sure you achieve the indicated level of precision, the movement of air around the TELEFAST ABE-7CPA412 must not exceed 0.1 m/s. Temperature variations must not exceed 10° C/hour and the TELEFAST ABE-7CPA412 must be placed at least 100mm away from all heat sources.

The TELEFAST ABE-7CPA412 can be operated from -40° C to +80° C external temperature.

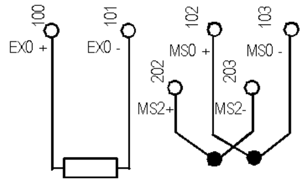
Connecting Sensors

Sensors may be connected to the TELEFAST ABE-7CPA412 accessory as shown in this illustration *(see page 128)*.

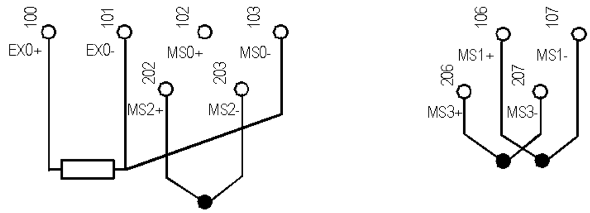
Wirings



Legend: Operating in TC mode with Telefast internal cold junction compensation.



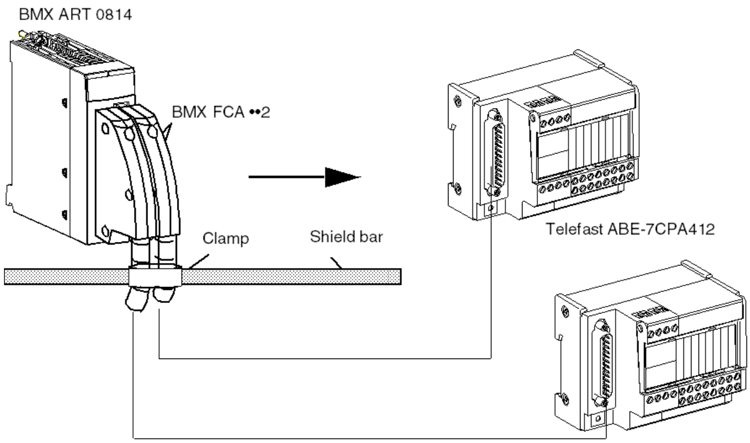
Legend: Operating in TC mode with cold junction compensation using a 2-wire PT100 probe.



Legend: Operating in TC mode with cold junction compensation using a 3-wire PT100 probe.

Connecting Modules

Modules can be connected to a TELEFAST ABE-7CPA412 as shown in the illustration below:



The BMX ART 0414/0814 analog modules may be connected to the TELEFAST ABE-7CPA412 accessory using one of the following cables:

- BMX FCA 152: length 1.5 m
- BMX FCA 302: length 3 m
- BMX FCA 502: length 5 m

BMX AMO 0210 Analog Output Module

7

Subject of this Chapter

This chapter presents the BMX AMO 0210 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

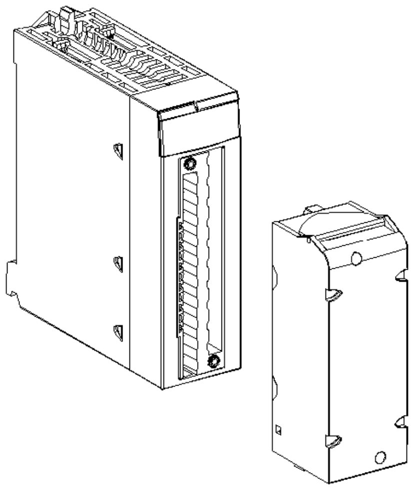
The BMX AMO 0210 is a module with two analog outputs isolated from one other. It offers the following ranges for each output:

- Voltage +/-10 V
- Current 0..20 mA and 4..20 mA

The range is selected during configuration.

Illustration

The BMX AMO 0210 analog output module looks like this.



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMO 0210 and BMX AMO 0210H *(see page 45)* modules are as follows.

Type of outputs		Isolated high level outputs
Nature of outputs		Voltage or Current configured by software
Number of channels		2
Analog/Digital converter resolution		15 bits + sign
Output refresh time		≤1 ms
Power supply for outputs		by the module
Types of protection		From short circuits and overloads (Voltage output)
Isolation:		
• Between channels		750 VDC
• Between channels and bus		1400 VDC
• Between channels and ground		1400 VDC
Measurement error for standard module:		
• At 25° C (77° F)		0.10% of FS (1)
• Maximum in the temperature range 0..60° C (32..140° F)		0.20% of FS (1)
Measurement error for ruggedized:		
• At 25° C (77° F)		0.10% of FS (1)
• Maximum in the temperature range -25..70° C (-13..158° F)		0.45% of FS (1)
Temperature drift		30 ppm/° C
Monotonicity		Yes
Non linearity		0.1% of FS
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	2.3 W
	Maximum	2.8 W
Legend		
(1) FS: Full Scale		

Voltage Output

The BMX AMO 0210 and BMX AMO 0210H *(see page 45)* voltage outputs have the following characteristics.

Nominal variation range	+/-10 V
Maximum variation range	+/- 11.25 V
Analog resolution	0.37 mV
Load impedance	1 KΩ minimum
Detection type	Short circuits

Current Output

The BMX AMO 0210 and BMX AMO 0210H *(see page 45)* current outputs have the following characteristics.

Nominal variation range	0..20 mA, 4..20 mA
Available maximum current	24 mA
Analog resolution	0.74 µA
Load impedance	600 Ω maximum
Detection type	Open circuit (1)
Legend (1) The open circuit detection is physically detected by the module if the target current value is different of 0 mA.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- internal cycle time = 1 ms for the two channels
- digital/analog conversion response time = 1 ms maximum for a 0-100% step.

NOTE: If nothing is connected on the BMX AMO 0210 analog module and the channels are configured in the range 4..20 mA, there is a detected I/O error as if a wire is broken.

For the 0..20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.

- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

Failure to follow these instructions can result in injury or equipment damage.

Functional Description

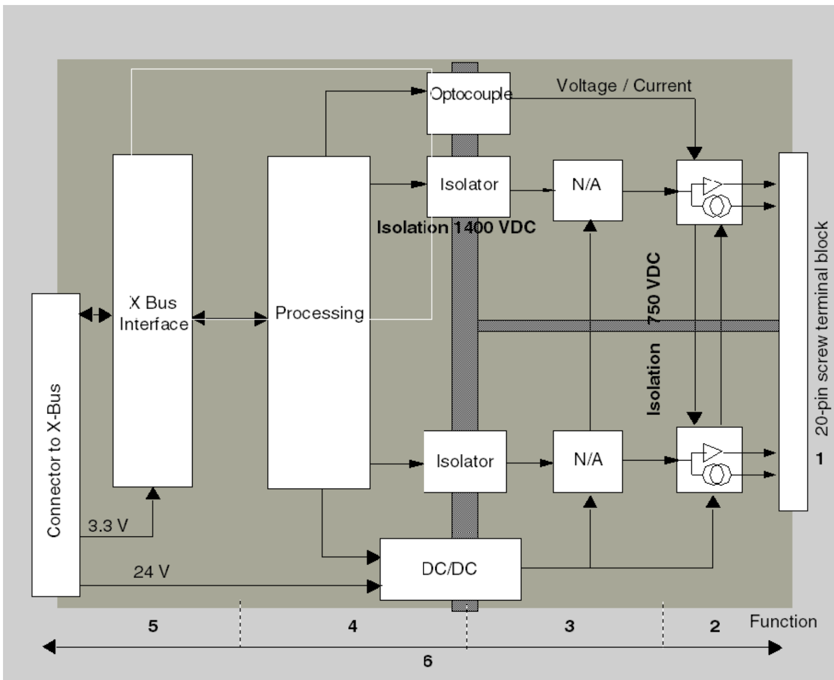
Function

The BMX AMO 0210 is a module with 2 analog outputs isolated from each other.
This module offers the following ranges for each output, according to the selection made during configuration:

- +/-10 V
- 0...20 mA
- 4...20 mA

Illustration

The BMX AMO 0210 module's illustration is as follows.



Description.

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal to the Actuators	• the adaptation is performed on voltage or current via software configuration
3	Converting	• this conversion is performed on 15 bits with a polarity sign • reframing the data provided by the program is performed automatically and dynamically by the converter
4	Transforming application data into data directly usable by the digital/analog converter	• use of factory calibration parameters
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • receiving, from the application, configuration parameters for the module and channels, as well as numeric setpoints from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

The application must provide the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mA and 4-20 mA ranges

Digital/Analog Conversion

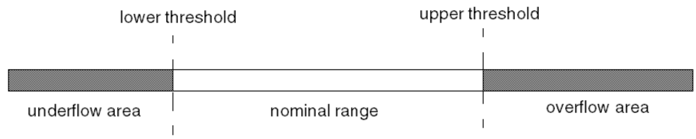
The digital/analog conversion is performed on:

- 16-bit for the +/-10 V range
- 15-bit in 0-20 mA and 4-20 mA ranges

Overflow Control

Module BMX AMO 0210 allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows.

Range	BMX AMO 0210					
	Underflow Area		Nominal Range		Overflow Area	
+/- 10V	-11,250	-11,001	-11,000	11,000	11,001	11,250
0..20mA	-2,000	-1,001	-1,000	11,000	11,001	12,000
4..20mA	-1,600	-801	-800	10800	10801	11,600

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

In case of error, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs:

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or Maintain at current value is selected during the configuration of the module. The fallback value may be modified from the Debug in Unity Pro or through a program.

WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, an independent redundant system must be installed.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

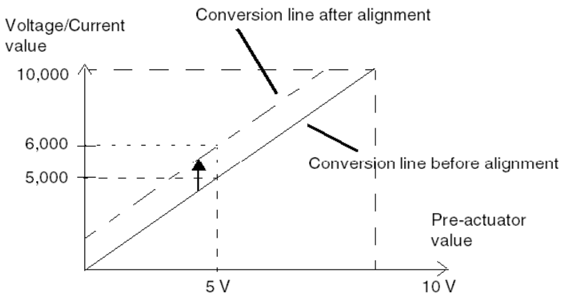
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the actuator or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

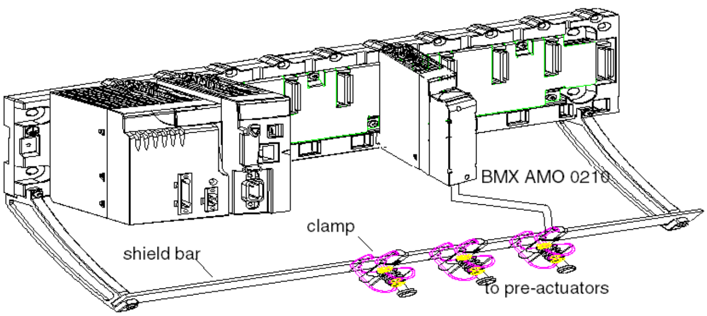
Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. It is nevertheless preferable to avoid returning a remote ground potential to the terminal; this may be very different to the ground potential close by.

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazard instructions

⚠ CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations:

- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding without programmable filtering,

Electromagnetic perturbations may lead to an unexpected behavior of the application.

Failure to follow these instructions can result in injury or equipment damage.

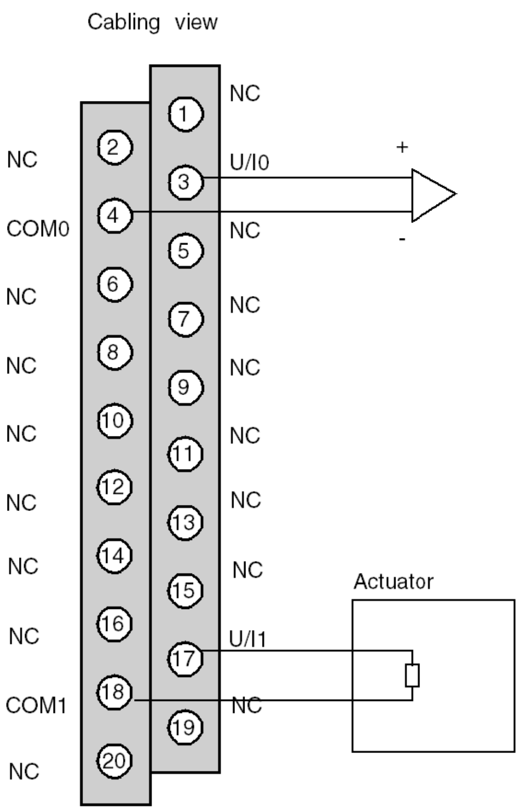
Wiring Diagram

Introduction

The actuators are connected using the 20-point terminal block.

Illustration

The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows.



U/Ix + pole input for channel x
COMx - pole input for channel x
Channel 0: Voltage actuator
Channel 1: Current actuator

Use of the TELEFAST ABE-7CPA21 Wiring Accessory

Introduction

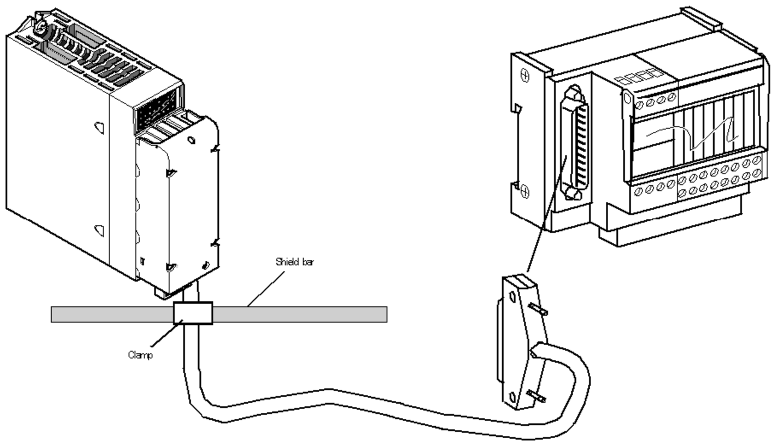
The BMXAMO0210 module can be connected to a TELEFAST ABE-7CPA21 accessory.

The module is connected using one of the following cables:

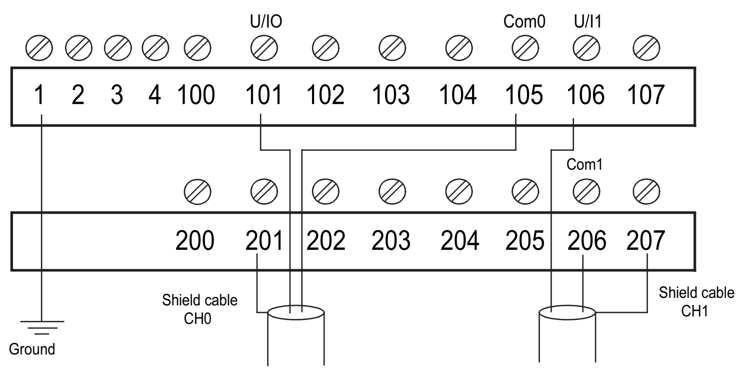
- BMX FCA 150: length 1.5 m
- BMX FCA 300: length 3 m
- BMX FCA 500: length 5 m

Illustration

The TELEFAST ABE-7CPA21 is connected as shown in the illustration below:



The analog outputs are accessible on the terminals of the TELEFAST ABE-7CPA21 as follows:



BMX AMO 0410 Analog Output Module

8

Subject of this Chapter

This chapter presents the BMX AMO 0410 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

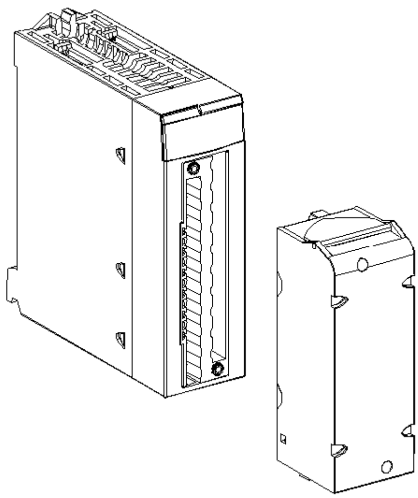
The BMX AMO 0410 is a high density output analog module fitted with four isolated channels. It offers the following ranges for each output:

- Voltage +/-10 V
- Current 0..20 mA and 4..20 mA

The range is selected during configuration.

Illustration

The following graphic shows the BMX AMO 0410 analog output module:



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMO 0410 and BMX AMO 0410H *(see page 45)* modules are as follows:

Type of outputs		High level Fast outputs
Nature of outputs		Voltage or Current configured by software
Number of channels		4
Digital/Analog converter resolution		16 bits
Output refresh time		1 ms
Power supply for outputs		by the module
Types of protection		From short circuits and overloads (Voltage output)
Isolation: ● Between channels ● Between channels and bus ● Between channels and ground		 750 VDC 1400 VDC 1400 VDC
Measurement error for standard module: ● At 25° C (77° F) ● Maximum in the temperature range 0..60° C (32..140° F)		 0.10% of FS (1) 0.20% of FS (1)
Measurement error for ruggedized: ● At 25° C (77° F) ● Maximum in the temperature range -25..70° C (-13..158° F)		 0.10% of FS (1) 0.45% of FS (1)
Temperature drift		45 ppm/° C
Monotonicity		Yes
Non linearity		0.1% of FS
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.48 W
	Maximum	0.61 W
Power consumption (24 V)	**Typical**	3.0 W
	Maximum	3.2 W
Legend (1) FS: Full Scale		

Voltage Output

The BMX AMO 0410 and BMX AMO 0410H *(see page 45)* voltage outputs have the following characteristics:

Nominal variation range	+/-10 V
Maximum variation range	+/- 10.50 V
Analog resolution	0.37 mV
Load impedance	1 KΩ minimum
Detection type	Short circuits

Current Output

The BMX AMO 0410 and BMX AMO 0410H *(see page 45)* current outputs have the following characteristics:

Nominal variation range	0..20 mA, 4..20 mA
Available maximum current	21 mA
Analog resolution	0.74 µA
Load impedance	500 Ω maximum
Detection type	Open circuit (1)
Legend (1) The open circuit detection is physically detected by the module if the target current value is different from 0 mA.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- Internal cycle time = 1 ms for the four channels
- Digital/Analog conversion response time = 1 ms maximum for a 0-100% step.

NOTE: If nothing is connected on the BMX AMO 0410 analog module and the channels are configured in the range 4..20 mA, there is a detected I/O error as if a wire is broken.

For the 0..20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.

- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

Failure to follow these instructions can result in injury or equipment damage.

Functional Description

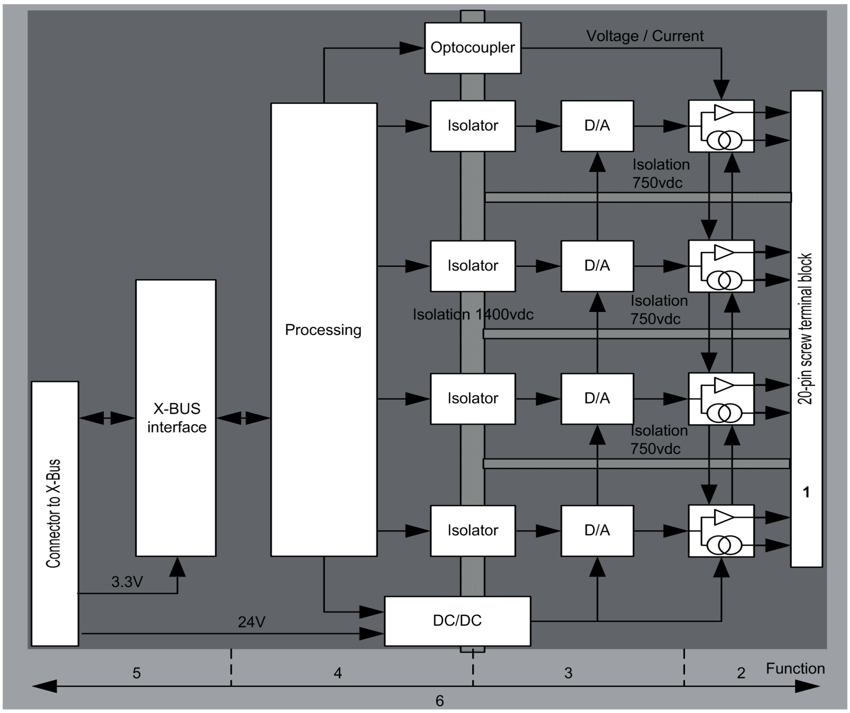
Function

The BMX AMO 0410 is a high density output analog module fitted with four isolated channels. This module offers the following ranges for each output, according to the selection made during configuration:

- +/-10 V
- 0...20 mA
- 4...20 mA

Illustration

The BMX AMO 0410 module's illustration is as follows:



Description:

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal to the Actuators	• the adaptation is performed on voltage or current via software configuration
3	Converting	• this conversion is performed on 15 bits with a polarity sign • reframing the data provided by the program is performed automatically and dynamically by the converter
4	Transforming application data into data directly usable by the digital/analog converter	• use of factory calibration parameters
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • from the application, receiving the configuration parameters for the module and channels as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

The application must provide the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mV and 4-20 mA ranges

Digital/Analog Conversion

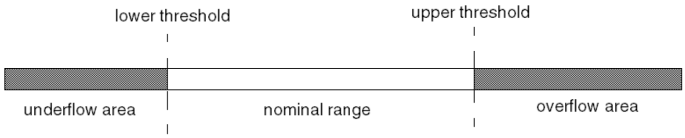
The digital/analog conversion is performed on:

- 16-bit for the +/-10 V range
- 15-bit in 0-20 mA and 4-20 mA ranges

Overflow Control

Module BMX AMO 0410 allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows:

Range	BMX AMO 0410					
	Underflow Area		Nominal Range		Overflow Area	
+/- 10V	-10,500	-10,301	-10,300	10,300	10,301	10,500
0..20mA	-2,000	-1,001	-1,000	10,300	10,301	10,500
4..20mA	-1,600	-801	-800	10,300	10,301	10,500

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

If an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs:

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or Maintain at current value is selected during the configuration of the module. The fallback value may be modified from the Debug in Unity Pro or through a program.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, an independent redundant system must be installed.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

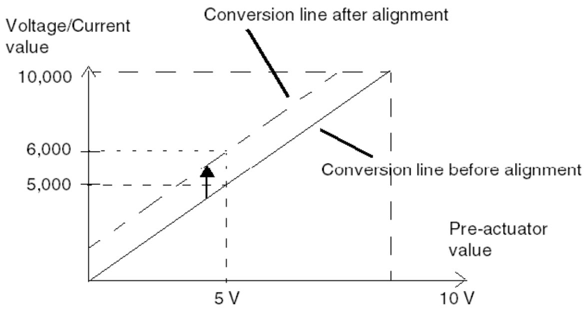
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the actuator or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

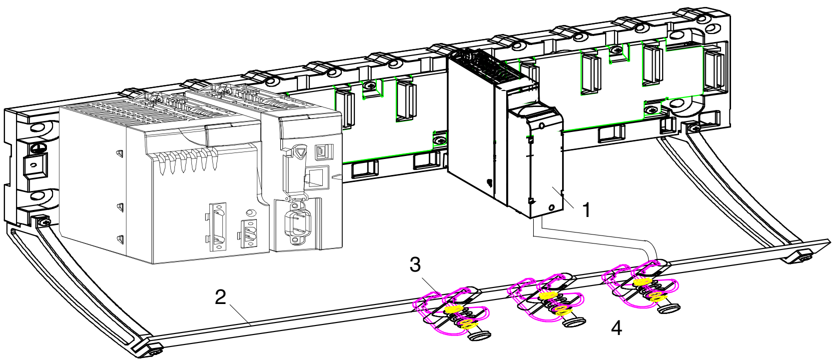
Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMO 0410
2 Shield bar
3 Clamp
4 To pre-actuators

Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. It is nevertheless preferable to avoid returning a remote ground potential to the terminal that may be different to the ground potential close by.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Ensure that:

- potentials greater than safety limits cannot exist,
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazard instructions

⚠ CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations:

- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding without programmable filtering,

Electromagnetic perturbations may lead to an unexpected behavior of the application.

Failure to follow these instructions can result in injury or equipment damage.

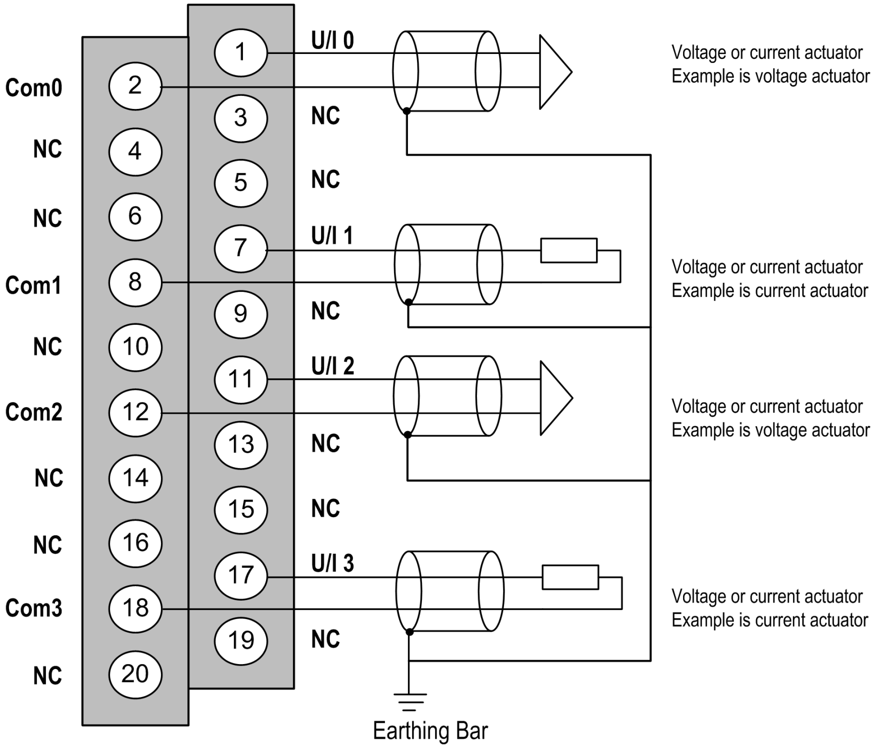
Wiring Diagram

Introduction

The actuators are connected using the 20-pin terminal block.

Illustration

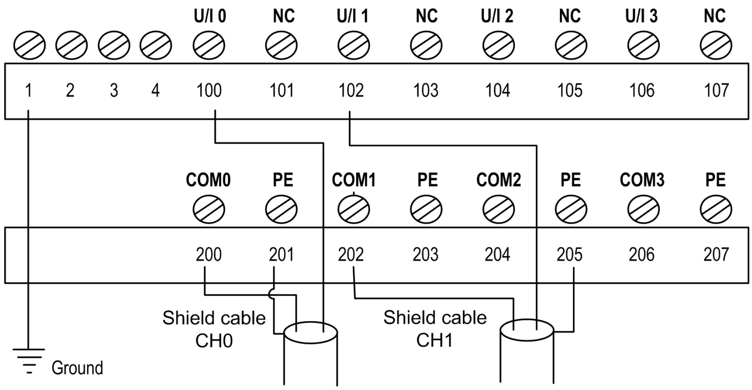
The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows:



U/Ix + pole input for channel x
COMx - pole input for channel x
Channel 0: Voltage actuator
Channel 1: Current actuator

Wiring Accessories

BMX AMO 0410 is connected to the Telefast module ABE-7CPA21 *(see page 150)* with the cable BMX FCA 150/300/500.



Use of the TELEFAST ABE-7CPA21 Wiring Accessory

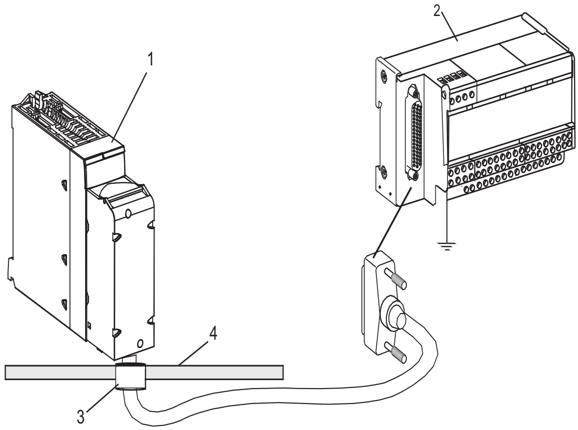
Introduction

The BMX AMO 0410 module can be connected to a TELEFAST ABE-7CPA21 accessory.

The module is connected using one of the following cables:
- BMX FCA 150: length 1.5 m (4.92 ft)
- BMX FCA 300: length 3 m (9.84 ft)
- BMX FCA 500: length 5 m (16.40 ft)

Connecting Modules

The TELEFAST ABE-7CPA21 is connected as shown in the illustration below:



1 BMX AMO 0410
2 Telefast ABE-7CPA21
3 Clamp
4 Shield bar

Connecting Actuators

Actuators may be connected to the ABE-7CPA21 accessory as shown in the illustration *(see page 178)*.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA21:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMO0410 pin out	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMO0410 pin out	Signal type
1	/		Ground	Supp 1	/		Ground
2	/		STD (1)	Supp 2	/		Ground
3	/		STD (1)	Supp 3	/		Ground
4	/		STD (2)	Supp 4	/		Ground
100	1	1	U/I0	200	14	2	Com 0
101	2		NC	201	/		Ground
102	15	7	U/I1	202	3	8	Com 1
103	16		NC	203	/		Ground
104	4	11	U/I2	204	17	12	Com 2
105	5		NC	205	/		Ground
106	18	17	U/I3	206	6	18	Com 3
107	19		NC	207	/		Ground
NC: Not Connected							

NOTE: The strap with the ABE-7CPA21 must be removed from the terminal, otherwise the signal ground of channel 0 will be connected to earth.

For the ground connection use the additional terminal block ABE-7BV20.

BMX AMO 0802 Analog Output Module

9

Subject of this Chapter

This chapter presents the BMX AMO 0802 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

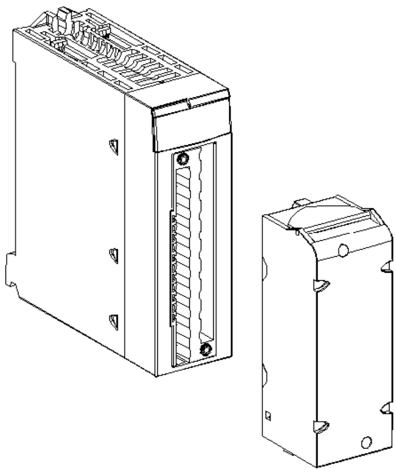
The BMX AMO 0802 is a high density output analog module fitted with 8 non-isolated channels. It offers the following current ranges for each output:

- 0..20 mA
- 4..20 mA

The range is selected during configuration.

Illustration

The following graphic shows the BMX AMO 0802 analog output module:



NOTE: The terminal block is supplied separately.

Characteristics

General Characteristics

The general characteristics for the BMX AMO 0802 and BMX AMO 0802H *(see page 45)* modules are as follows:

Type of outputs		Non-isolated high level outputs with common point
Nature of outputs		Current
Number of channels		8
Digital/Analog converter resolution		16 bits
Output refresh time		4 ms
Power supply for outputs		by the module
Types of protection		Outputs protected to short circuits and permanent overloads
Isolation:		
• Between channels		Non-isolated
• Between channels and bus		1400 VDC
• Between channels and ground		1400 VDC
Measurement error for standard module:		
• At 25° C (77° F)		0.10% of FS (1)
• Maximum in the temperature range 0..60° C (32..140° F)		0.25% of FS (1)
Measurement error for ruggedized:		
• At 25° C (77° F)		0.10% of FS (1)
• Maximum in the temperature range -25..70° C (-13..158° F)		0.45% of FS (1)
Temperature drift		45 ppm/° C
Monotonicity		Yes
Non linearity		0.1% of FS
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	3.40 W
	Maximum	3.70 W
Legend		
(1) FS: Full Scale		

Current Output

The BMX AMO 0802 and BMX AMO 0802H *(see page 45)* current outputs have the following characteristics:

Nominal variation range	0..20 mA, 4..20 mA
Available maximum current	21 mA
Analog resolution	0.74 µA
Load impedance	350 Ω maximum
Detection type	Open circuit (1)
Legend (1) The open circuit detection is physically detected by the module if the target current value is different from 0 mA.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 5 ms:
- Internal cycle time = 4 ms for the eight channels
- Digital/Analog conversion response time = 1 ms maximum for a 0-100% step.

NOTE: If nothing is connected on the BMX AMO 0802 analog module and the channels are configured in the range 4..20 mA, there is a detected I/O error as if a wire is broken.

For the 0..20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.
- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

Failure to follow these instructions can result in injury or equipment damage.

Functional Description

Function

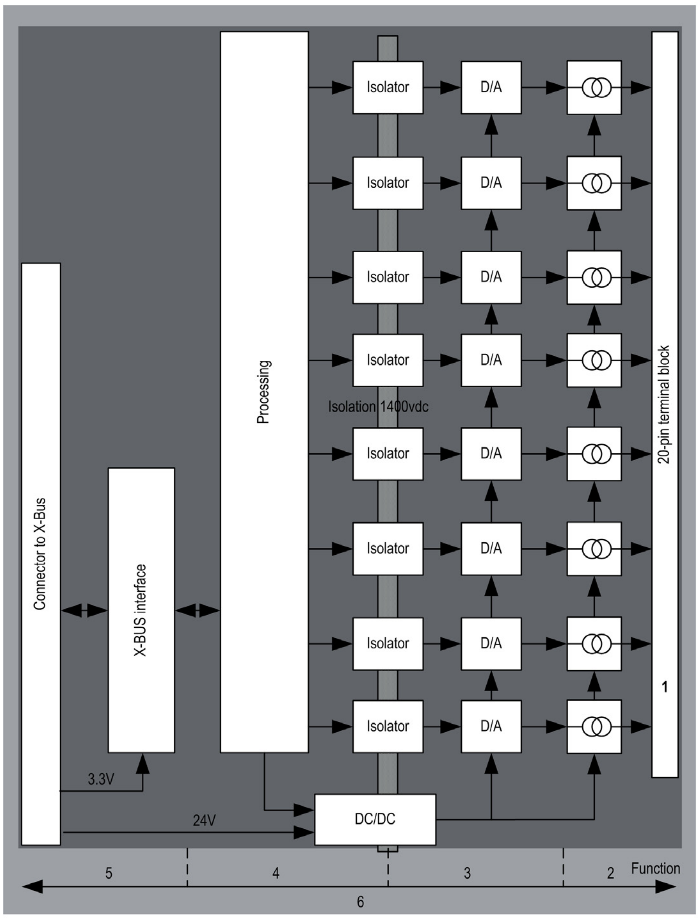
The BMX AMO 0802 is a high density output analog module fitted with 8 non-isolated channels. It offers the following current ranges for each output:

- 0..20 mA
- 4..20 mA

The range is selected during configuration.

Illustration

The BMX AMO 0802 module’s illustration is as follows:



Description:

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal to the Actuators	• the adaptation is performed on current via software configuration
3	Converting	• this conversion is performed on 15 bits with a polarity sign • reframing the data provided by the program is performed automatically and dynamically by the converter
4	Transforming application data into data directly usable by the digital/analog converter	• use of factory calibration parameters
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • from the application, receiving the configuration parameters for the module and channels as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

The application must provide the outputs with values in the standardized format: 0 to +10,000 in 0..20 mV and 4..20 mA ranges.

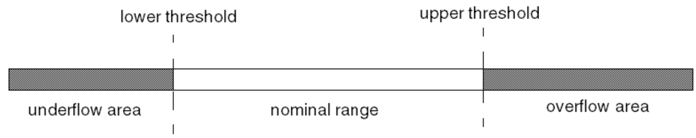
Digital/Analog Conversion

The digital/analog conversion is performed on: 15-bit in 0..20 mA and 4..20 mA ranges.

Overflow Control

Module BMX AMO 0802 only allows an overflow control on current ranges.

The measurement range is divided in three areas:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows:

Range	BMX AMO 0802					
	Underflow Area		Nominal Range		Overflow Area	
0..20mA	-2,000	-1,001	-1,000	10,300	10,301	10,500
4..20mA	-1,600	-801	-800	10,300	10,301	10,500

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

If an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 mA.

Various Behaviors of Outputs:

Error	Behavior of Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)
Communication interruption	
Configuration Error	0 mA (all channels)
Internal Error in Module	
Output Value out-of-range (range under/overflow)	Saturated value (channel by channel)
Output open circuit	Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 mA (all channels)
Reloading Program	

Fallback or Maintain at current value is selected during the configuration of the module. The fallback value may be modified from the Debug in Unity Pro or through a program.

WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, an independent redundant system must be installed.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

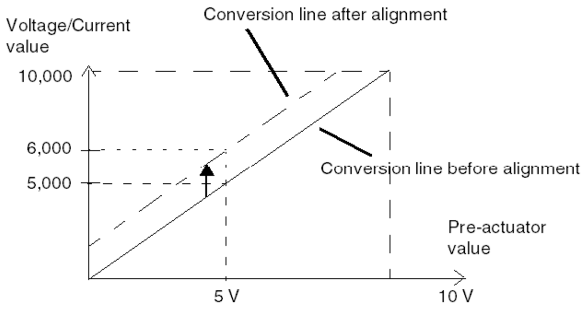
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 mA.

Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the actuator or changing the sensor’s operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

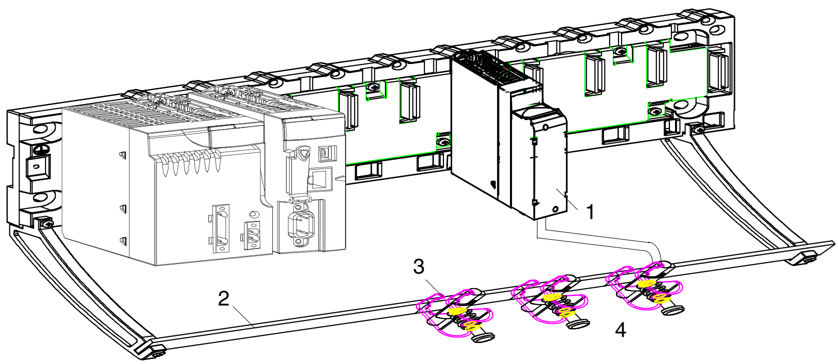
Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMO 0802
2 Shield bar
3 Clamp
4 To pre-actuators

Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. It is nevertheless preferable to avoid returning a remote ground potential to the terminal that may be different to the ground potential close by.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazard instructions

CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations:

- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding without programmable filtering,

Electromagnetic perturbations may lead to an unexpected behavior of the application.

Failure to follow these instructions can result in injury or equipment damage.

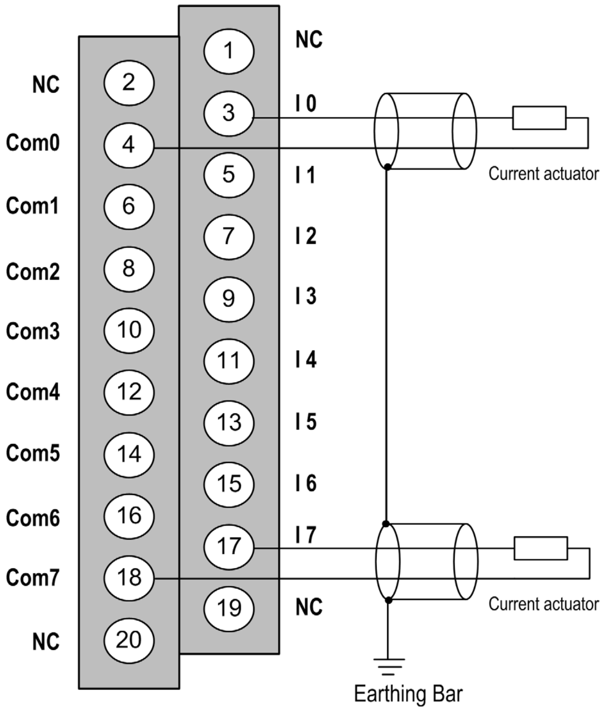
Wiring Diagram

Introduction

The actuators are connected using the 20-pin terminal block.

Illustration

The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows:



Ix + pole input for channel x.
COMx - pole input for channel x, COMx are connected together internally.

Wiring Accessories

Two cords BMX FTA 152/302 are provided in two lengths (1.5m (4.92 ft), 3m (9.84 ft)) to connect the module to a Telefast interface ABE7CPA02 *(see page 179)*.

Use of the TELEFAST ABE-7CPA02 Wiring Accessory

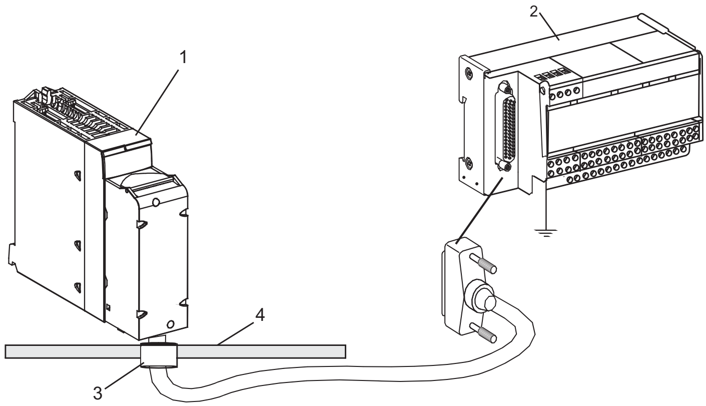
Introduction

The BMX AMO 0802 module can be connected to a TELEFAST ABE-7CPA02 accessory.

The module is connected using one of the following cables:
- BMX FTA 152: length 1.5 m (4.92 ft)
- BMX FTA 302: length 3 m (9.84 ft)

Connecting Modules

The TELEFAST ABE-7CPA02 is connected as shown in the illustration below:



1 BMX AMO 0802
2 Telefast ABE-7CPA02
3 Clamp
4 Shield bar

Connecting Actuators

Actuators may be connected to the ABE-7CPA02 accessory as shown in the illustration *(see page 178)*.

The following table shows the distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMO0802 pin out	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	AMO0802 pin out	Signal type
1	/		Ground	Supp 1	/		Ground
2	/		STD (1)	Supp 2	/		Ground
3	/		STD (1)	Supp 3	/		Ground
4	/		STD (2)	Supp 4	/		Ground
100	1	3	I0	200	14	4	COM0
101	2		NC	201	/		Ground
102	15	5	I1	202	3	6	COM1
103	16		NC	203	/		Ground
104	4	7	I2	204	17	8	COM2
105	5		NC	205	/		Ground
106	18	9	I3	206	6	10	COM3
107	19		NC	207	/		Ground
108	7	11	I4	208	20	12	COM4
109	8		NC	209	/		Ground
110	21	13	I5	210	9	14	COM5
111	22		NC	211	/		Ground
112	10	15	I6	212	23	16	COM6
113	11		NC	213	/		Ground
114	24	17	I7	214	12	18	COM7
115	25		NC	215	/		Ground
Ix: + pole voltage input for channel x COMx: - pole voltage or current input for channel x NC: Not Connected							

NOTE: The strap must be removed from the ABE-7CPA02 terminal, otherwise the signal ground of channels will be connected with earth.

For the ground connction use the additional terminal block ABE-7BV20.

BMX AMM 0600 Analog Input/Output Module

10

Subject of this Chapter

This chapter presents the BMX AMM 0600 module, its characteristics, and explains how it is connected to the various sensors and pre-actuators.

What Is in This Chapter?

This chapter contains the following topics:

Presentation

Function

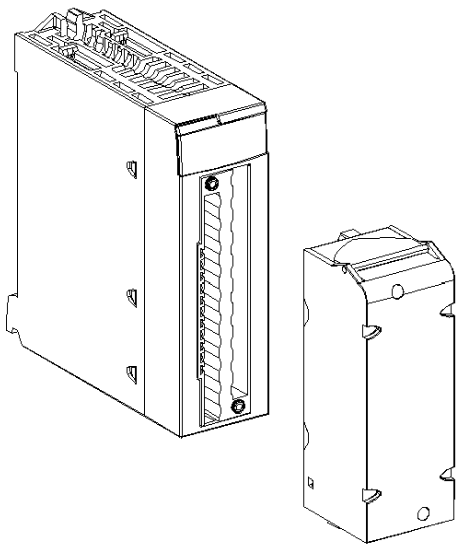
The BMX AMM 0600 Input/Output module combines 4 non-isolated analog inputs with 2 non-isolated analog outputs.

The BMX AMM 0600 module offers the following range, according to the selection made during configuration:

- Voltage input range +/-10 V/0..10 V/0..5 V/1..5 V
- Current input range 0...20 mA/4...20 mA
- Voltage output range +/-10 V
- Current output range 0...20 mA/4...20 mA

Illustration

BMX AMM 0600 analog input/output module looks like this.



NOTE: The 20-pin terminal block is supplied separately.

Characteristics

General Inputs Characteristics

The **BMX AMM 0600** and BMX AMM 0600H *(see page 45)* general input characteristics are as follows:

Type of inputs		Non-isolated single ended inputs
Nature of inputs		Voltage / Current (250 Ω internally protected resistors)
Number of channels		4 inputs
Acquisition cycle time:		
• fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• default (periodic acquisition for all channels)		5 ms
Resolution		14-bit in +/- 10 V 12-bit in 0...5 V
Digital filtering		1st order
Isolation:		
• between inputs channels group and output channels group		750 VDC
• between channels and bus		1400 VDC
• between channels and ground		1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 90 mA
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	1.3 W
	Maximum	2.8 W

Input Measurement Range

The **BMX AMM 0600** and BMX AMM 0600H *(see page 45)* have the following input measurement range characteristics:

Measurement range	**+/-10 V/ +/-5 V; 0..10 V; 0..5 V; 1..5 V**	**0..20 mA/4..20 mA**
Maximum conversion value	+/-11.25 V	0..30 mA
Resolution	1.42 mV	5.7 µA
Input impedance	10 MΩ	250 Ω internal conversion resistor
Precision of the internal conversion resistor	-	0.1%-15 ppm/° C
Measurement error for inputs for standard modules:		
• At 25° C (77° F) • Maximum in the temperature range 0...60° C (-32...140° F)	0.25% of FS(1) 0.35% of FS(1)	0.35% of FS(1, 2) 0.50% of FS(1, 2)
Measurement error for inputs for Hardened modules:		
• At 25° C (77° F) • Maximum in the temperature range -25...70° C (-13...158° F)	0.25% of FS(1) 0.40% of FS(1)	0.35% of FS(1, 2) 0.60% of FS(1, 2)
Input temperature drift	30 ppm/° C	50 ppm/° C
Monotonicity	Yes	Yes
Non linearity	0.10% of FS	0.10% of FS
Legend: (1) FS: Full Scale (2) With conversion resistor error		

NOTE: If nothing is connected on **BMX AMM 0600** and **BMX AMM 0600H** analog input/output module and if channels are configured (range 4-20 mA or 1-5 V) a broken wire causes a detected I/O error.

General Output Characteristics

The **BMX AMM 0600** and **BMX AMM 0600H** general output characteristics are as follows:

Type of Outputs	2 Non-isolated Outputs
Range configuration	Voltage or self-powered current range selection by firmware

Voltage range

The **BMX AMM 0600** and **BMX AMM 0600H** voltage range has the following characteristics:

Nominal variation range	+/-10 V
Maximum variation range	+/- 11.25 V
Voltage resolution	12 bits
Measurement error for standard module:	
• At 25°C (77°F) • Maximum in the temperature range 0...60°C (-32...140°F)	0.25% of FS(1) 0.60% of FS(1)
Measurement error for ruggedized module:	
• At 25°C (77°F) • Maximum in the temperature range -25...70°C (-13...158°F)	0.25% of FS(1) 0.80% of FS(1)
Temperature drift	100 ppm/°C
Monotonicity	Yes
Non linearity	0.1% of FS
AC output ripple	2 mV rms on 50 Ω BW < 25MHz
Load impedance	1 KΩ minimum
Detection type	Short circuits and overloads

Current Range

The **BMX AMM 0600** and **BMX AMM 0600H** current range has the following characteristics.

Nominal variation range	0..20 mA/4..20 mA
Available maximum current	24 mA
Current resolution	11 bits
Measurement error:	
• at 25° C (77° F) • maximum in temperature ranges	0.25% of FS(1) 0.60% of FS(1)
Temperature drift	100 ppm/° C
Monotonicity	Yes
Non linearity	0.1% of FS
AC output ripple	2 mV rms on 50 Ω BW < 25MHz
Load impedance	600 Ω maximum
Detection type	Open circuit (1)
Legend	
(1) The open circuit detection is physically detected by the module in range 4...20 mA.It is also detected if the target current value is different from 0 mA in range 0...20 mA.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- internal cycle time = 1 ms for the two outputs
- digital/analog conversion response time = 1ms maximum for a 0-100% step.

Functional Description

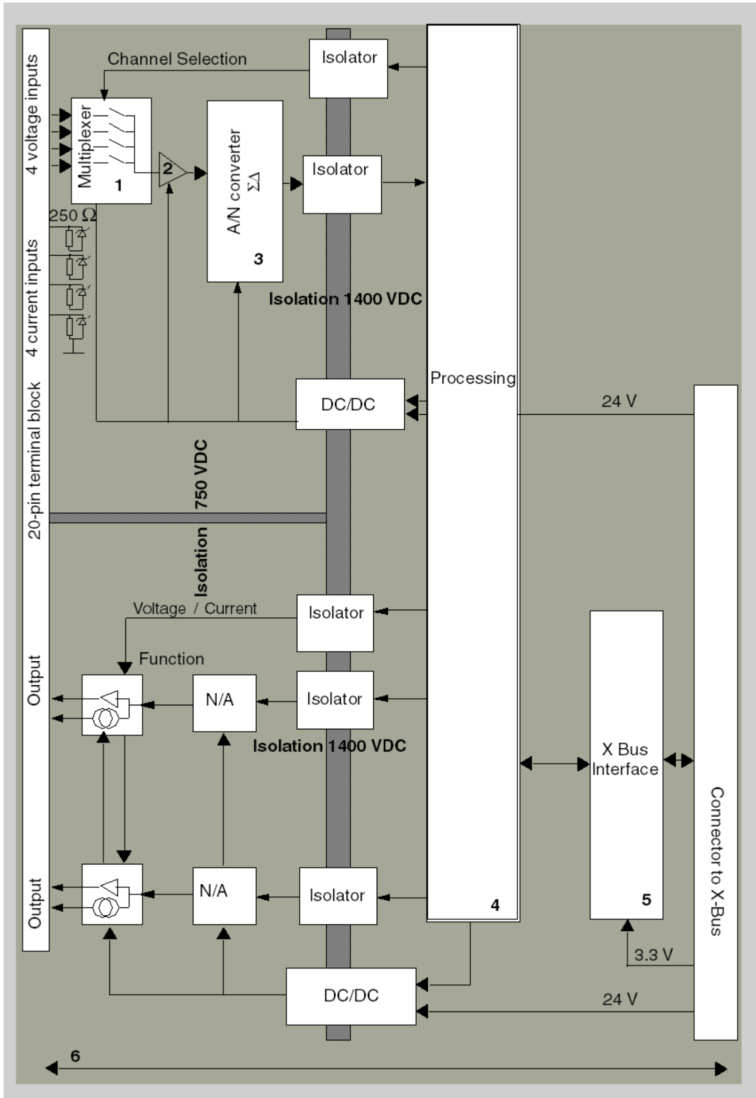
Function

The BMX AMM 0600 Input/Output module combines 4 non-isolated analog inputs with 2 non-isolated analog outputs. However, input and output blocks are isolated.

The BMX AMM 0600 module offers the following range, according to the selection made during configuration:
- Voltage input range +/-10 V/0..10 V/0..5 V/1..5 V
- Current input range 0...20 mA/4...20 mA
- Voltage output range +/-10 V
- Current output range 0...20 mA/4...20 mA

Illustration

The BMX AMM 0600 module's illustration is as follows.



Description.

Address	Process	Characteristics
1	Adaptation	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal	• the adaptation is performed on voltage or current via software configuration
3	Converting	• this conversion is performed on 13 bits with a polarity sign • reframing the data provided by the program is performed automatically and dynamically by the converter
4	Transforming application data into data directly usable by the digital/analog converter	• use of factory calibration parameters
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • receiving, from the application, configuration parameters for the module and channels, as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• testing for range overflow on channels • testing for output open circuits or short-circuits • watchdog test • Programmable fallback capabilities

Input functions: Measurement Timing

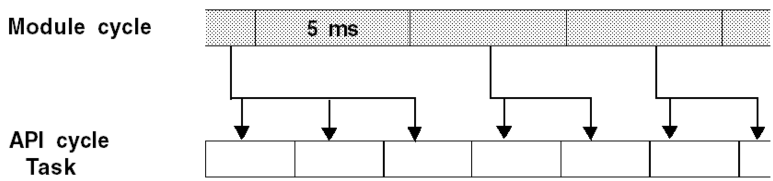
The timing of measurements is determined by the cycle selected during configuration: Normal or Fast Cycle.

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels In Use.

The cycle time values are based on the cycle selected.

Module	Normal Cycle	Fast Cycle
BMX AMM 0600	5 ms	1 ms + (1 ms x N) where N: number of channels in use.

NOTE: Module cycle is not synchronized with the PLC cycle. At the beginning of each PLC cycle, each channel value is taken into account. If the MAST/FAST task cycle time is less than the module's cycle time, some values will not have changed.

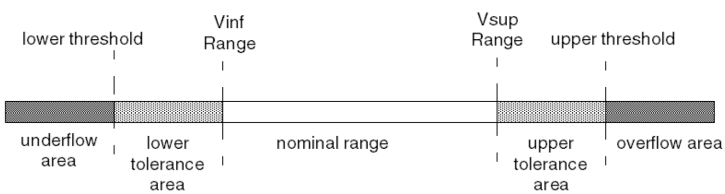


Input functions: Overflow/Underflow Control

Module BMX AMM 0600 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected, the module checks for overflow: it ensures that the measurement falls between a lower and an upper threshold.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Upper Tolerance Area	varies between the values included between the maximum value for the range (for instance: +10 V for the +/-10 V range) and the upper threshold
Lower Tolerance Area	varies between the values included between the minimum value for the range (for instance: -10 V for the +/-10 V range) and the lower threshold
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits.

	Range	BMX AMM 0600 Inputs									
		Underflow Area		Lower Tolerance Area		Nominal Range		Upper Tolerance Area		Overflow Area	
Uni-polar	0...10 V	-1,500	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
	0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
	1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bi-polar	+/- 10 V	-11,500	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
User	+/- 10 V	-32,768				User-defined	User-defined				32,767
	0...10 V	-32,768				User-defined	User-defined				32,767

Input functions: Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:
- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

The lower and upper thresholds must be integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Input functions: Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where:

α = efficiency of the filter

Mesf(n) = measurement filtered at moment n

Mesf(n-1) = measurement filtered at moment n-1

Valg(n) = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

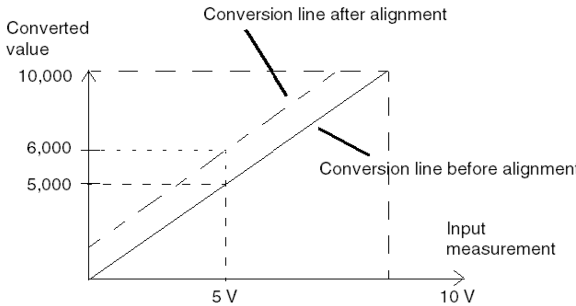
The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.0025 / T 0.0012 / T

Input functions: Sensor Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Replacing a module does not therefore require a new alignment. However, replacing the sensor or changing the sensor’s operating point does require a new alignment.

Conversion lines are as follows.



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- view and modify the desired measurement value
- save the alignment value
- determine whether the channel already has an alignment

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in standard operating mode, without any effect on the channel’s operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel to apply the parameters correctly.

Output Functions: Writing Outputs

The application must provide the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mV and 4-20 mA ranges

Digital/Analog Conversion

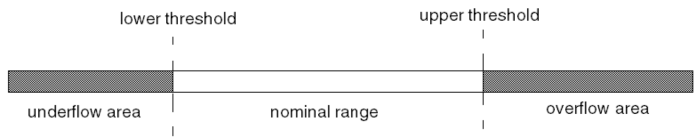
The digital/analog conversion is performed on:

- 12-bit in 0-20 mA, 4-20 mA ranges and for the +/-10 V range

Output Functions: Overflow Control

Module BMX AMM 0600 allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows.

Range	BMX AMM 0600 outputs					
	Underflow Area		**Nominal Range**		**Overflow Area**	
+/- 10V	-11,250	-11,001	-11,000	11,000	11,001	11,250
0..20mA	-2,000	-1,001	-1,000	11,000	11,001	12,000
4..20mA	-1,600	-801	-800	10,800	10,801	11,600

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Output Functions: Fallback/Maintain or Reset Outputs to Zero

In case of error, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs.

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short circuit or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or maintain at current value is selected during the module configuration. Fallback value may be modified from the Debug in Unity Pro or through a program.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, an independent redundant system must be installed.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

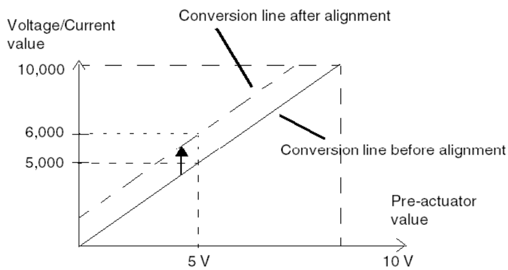
Output Functions: Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Output Functions: Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the actuator or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

T he maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: to align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel to apply the parameters correctly.

Wiring Precautions

Introduction

In order to protect the signal from outside interference induced in series mode and interference in common mode, we recommend that you take the following precautions.

Cable Shielding

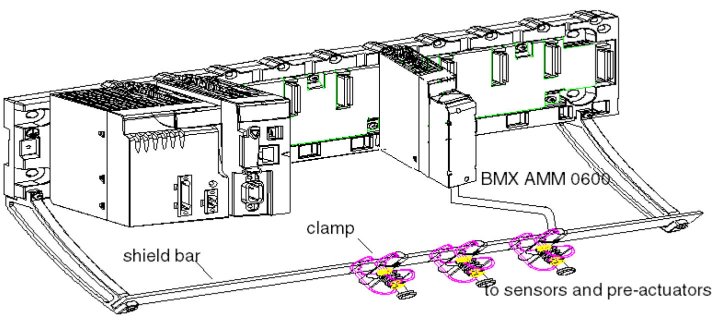
Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:
- make sure that each terminal block is still connected to the shield bar and
- disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



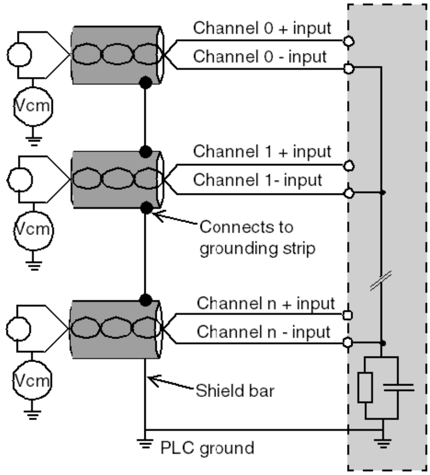
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, we recommend you take the following precautions:

- sensors must be close together (a few meters)
- all sensors must be referenced to a single point, which is connected to the PLC’s ground

Using Sensors with non Isolated Inputs

The inputs of the module are not isolated between them and single ended type. They do not admit any common mode voltage. The sensors are connected as indicated in the following diagram:



If one or more sensors are referenced in relation to the ground, this may in some cases return a remote ground current to the terminal block and disturbs the measures. It is therefore **essential** to follow the following rules:

- Use isolated from ground sensors if distance from sensors is > 30 meters or if power equipments are located near PLC.
- The potential must be less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC between sensors and shield.
- Setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. For safety reasons, it is nevertheless preferable to avoid returning a remote ground potential to the terminal; this may be very different to the ground potential close by.

Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazards instructions

⚠ WARNING

UNEXPECTED EQUIPEMENT OPERATION

Follow those instructions to reduce electromagnetic perturbations:

- adapt the programmable filtering to the frequency applied at the inputs,
- use the BMX XSP 0400/0600/0800/1200 electromagnetic protection kit *(see Modicon M340 Using Unity Pro, Processors, Racks, and Power Supply Modules, Setup Manual)* to connect the shielding,
- use a specific 24 VDC supply to sensors and a shielded cable for connecting the sensors to the module.

Electromagnetic perturbations may cause the application to operate in an unexpected manner.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

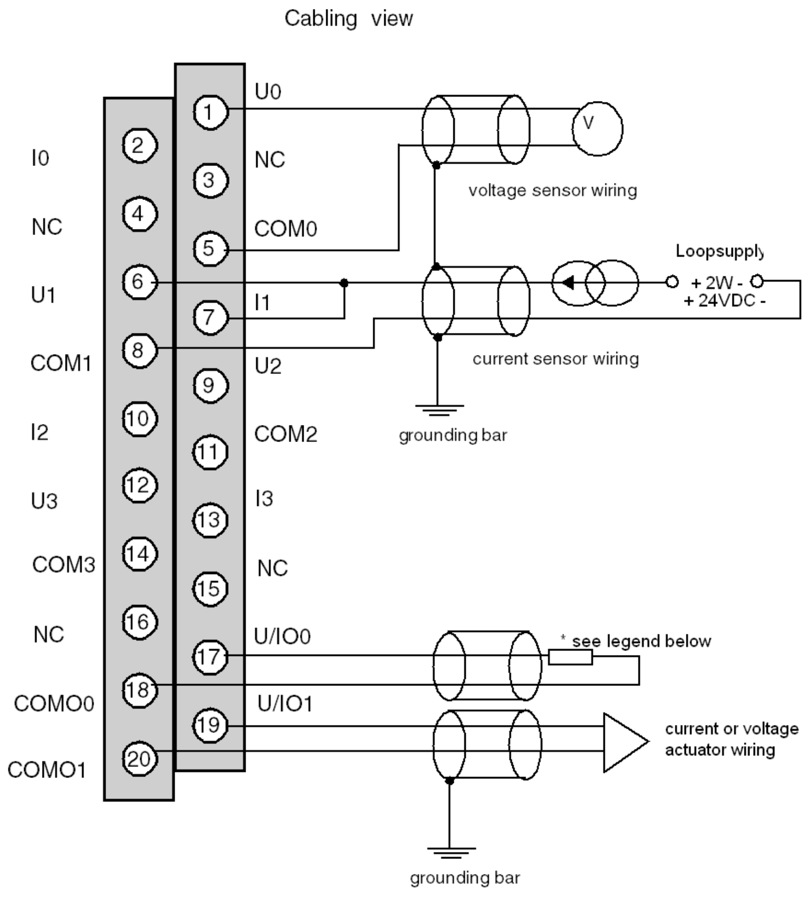
Wiring Diagram

Introduction

The actuators are connected using the 20-point terminal block.

Illustration

The terminal block connection, the sensors, and the actuators wiring are as follows.



Ux + pole input for channel x
COMx - pole input for channel x
U/IOx : + pole output for channel x
COMOx - pole output for channel x
* The current loop is self-powered by the output and does not request any external supply.

Software Implementation of Analog Modules

II

In this Part

This part sets forth general rules for implementing analog input/output modules with the Unity Pro Software program.

What Is in This Part?

This part contains the following chapters:

General Overview of Analog Modules

11

Introduction to the Installation Phase

Introduction

The software installation of application-specific modules is carried out from the various Unity Pro editors:

- in Offline mode,
- in Online mode.

If you do not have a processor to which you can connect, Unity Pro allows you to carry out an initial test using a simulator. In this case, the installation is different.

You are advised to follow the designated order of the installation phases. You may however change this order (by starting with the configuration phase, for example).

Installation Phases When Using a Processor

The following table presents the various installation phases when using a processor.

Phase	Description	Mode
Declaration of variables	declaration of IODDT-type variables for the application-specific modules and the project variables	Offline (1)
Programming	project programming	Offline (1)
Configuration	declaration of modules	Offline
	module channel configuration	
	entry of configuration parameters	
Association	association of IODDT variables with the configured channels (variable editor)	Offline (1)
Generation	project generation (analysis and editing of links)	Offline
Transfer	transfer project to PLC	Online
Legend: (1) These phases may also be performed online.		

Phase	Description	Mode
Adjustment/Debugging	project debugging from debug screens and animation tables	Online
	modifying the program and adjustment parameters	
Documentation	creating a documentation file and printing of the miscellaneous information relating to the project	Online (1)
Operation/Diagnostics	display of the miscellaneous information required to supervise the project	Online
	diagnostics of the project and modules	
Legend: (1) These phases may also be performed online.		

Installation Phases When Using a Simulator

The following table presents the various installation phases when using a simulator.

Phase	Description	Mode
Declaration of variables	declaration of IODDT-type variables for the application-specific modules and the project variables	Offline (1)
Programming	project programming	Offline (1)
Configuration	declaration of modules	Offline
	module channel configuration	
	entry of configuration parameters	
Association	association of IODDT variables with the configured modules (variable editor)	Offline (1)
Generation	project generation (analysis and editing of links)	Offline
Transfer	transfer project to simulator	Online
Simulation	program simulation without inputs/outputs	Online
Adjustment/Debugging	project debugging from debug screens and animation tables	Online
	modifying the program and adjustment parameters	
Legend: (1) These phases may also be performed online.		

Configuration of Modules

The configuration parameters may only be modified from the Unity Pro software.

Adjustment parameters may be modified either from the Unity Pro software (in debugging mode) or from the application.

Configuring Analog Modules

12

Subject of this Chapter

This chapter covers the configuration of a module with analog inputs and outputs.

What Is in This Chapter?

This chapter contains the following sections:

12.1 Configuring Analog Modules: Overview

Subject of this Section

This section describes the basic operations required to configure analog modules in a Modicon M340 local rack and in X80 drop.

What Is in This Section?

This section contains the following topics:

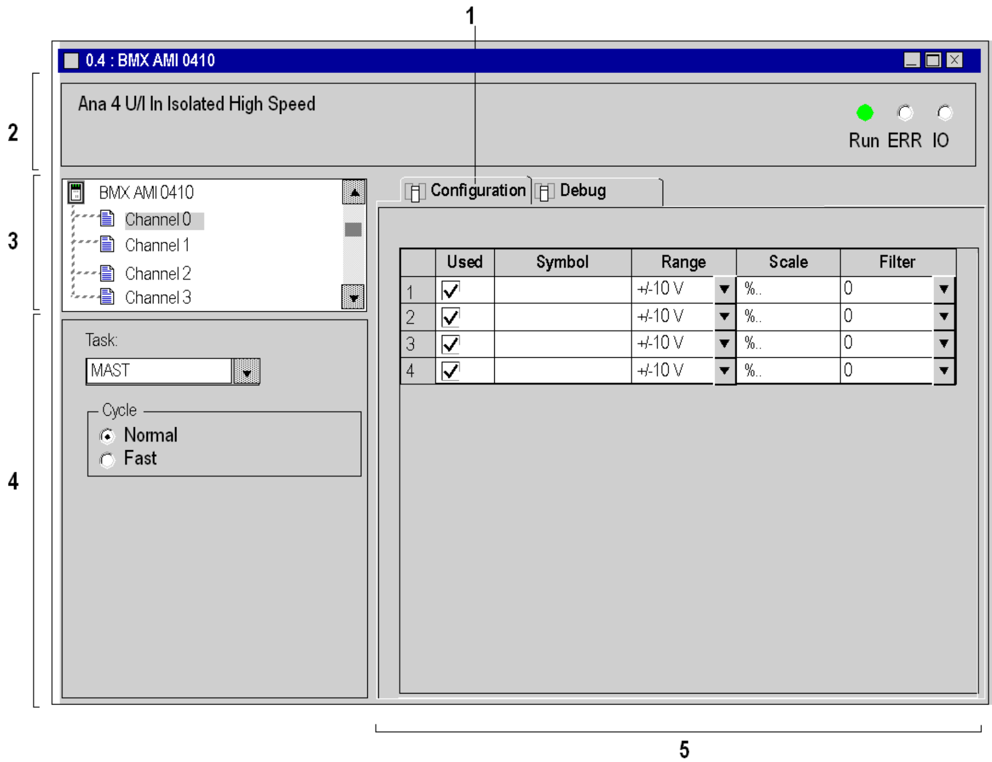
Description of the Configuration Screen of an Analog Module in a Modicon M340 Local Rack

At a Glance

The Configuration screen for the analog module selected displays parameters associated with the module in question.

Description

This screen is used to display and modify parameters in offline mode and in online mode.



The following table shows the different elements of the configuration screen and their functions.

No.	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Configuration** in this example). Each mode can be selected by the corresponding tab: ● **Configuration** ● **Debug**, accessible only in online mode.
2	Module area	Displays the abbreviated module indicator. In the same area there are 3 LEDs which indicate the status of the module in online mode: ● **RUN** indicates the operating status of the module. ● **ERR** signals a detected error within the module. ● **I/O** indicates an event from outside the module or an application error.

3	Channel area	Allows you:
		● By clicking on the reference number, to display the tabs:
		  ● **Description** which gives the characteristics of the device.
		  ● **I/O Objects** which is used to presymbolize the input/output objects.
		  ● **Fault** which shows the device status (in online mode).
		● To select a work channel
		● To display the **Symbol**, name of the channel defined by the user (using the variable editor).

4	General parameters area	This is used to set up the channels using several fields: ● **Task**: defines the **MAST** or **FAST** task through which the exchanges between the processor and the module will be carried out. ● **Cycle**: allows you to define the scan cycle for inputs (only available on some analog modules). ● **Rejection**: at 50 Hz or 60 Hz (only available on some analog modules). ● **Cold Junction Channel 0-3**: allows you to define the cold junction compensation according to the hardware used for channels 0 to 3 (only available on some analog modules).
5	Configuration area	This is used to define the configuration parameters of the different channels. This area includes several topics, whose display varies depending on the analog module you've selected. The **Symbol** column displays the symbol associated with the channel once it's been defined by the user (from the Variables Editor).

Description of the Configuration Screen of an Analog Module in X80 Drop

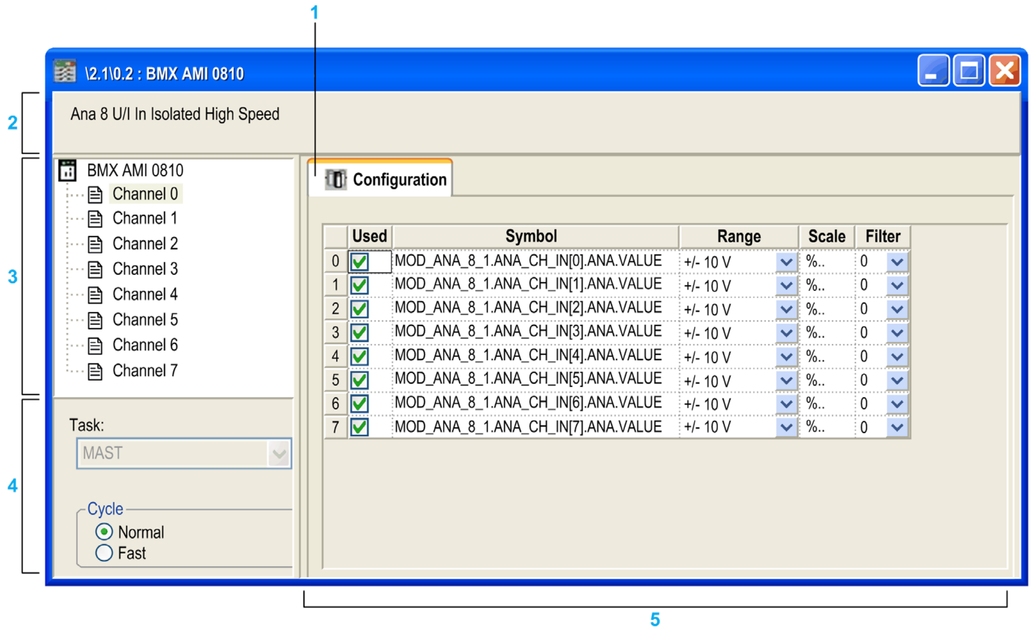
At a Glance

The various available screens for the analog modules are:

- **Configuration** screen
- **Device DDT** screen

Description

This screen is used to display and modify parameters:



The following table shows the different elements of the configuration screen and their functions.

Number	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Configuration** in this example). Each mode can be selected by the corresponding tab: ● **Overview** ● **Configuration** ● **Device DDT** which gives the Device DDT *(see page 242)* **name** and **type**.
2	**Module** area	Displays the abbreviated module indicator.
3	**Channel** area	Allows you: ● By clicking on the reference number, to display the tabs: ● **Description** which gives the characteristics of the device. ● To select a work channel ● To display the **Symbol**, name of the channel defined by the user (using the variable editor). **NOTE:** All channel are activated and a channel can not be desactivated to None.
4	**General parameters** area	This is used to set up the channels using several fields: ● **Task**: defines the **MAST** task through which the exchanges between the processor and the module will be carried out. ● **Cycle**: allows you to define the scan cycle for inputs (only available on some analog modules). ● **Rejection**: at 50 Hz or 60 Hz (only available on some analog modules). ● **Cold Junction Channel 0-3**: allows you to define the cold junction compensation according to the hardware used for channels 0 to 3 (only available on some analog modules).
5	**Configuration** area	This is used to define the configuration parameters of the different channels. This area includes several topics, whose display varies depending on the analog module you've selected. The **Symbol** column displays the symbol associated with the channel once it's been defined by the user (from the Variables Editor).

12.2 Parameters for Analog Input/Output Channels

Subject of this Section

This section describes the various input/output channel parameters for an analog module.

What Is in This Section?

This section contains the following topics:

Parameters for Analog Input Modules

At a Glance

Analog input modules include channel-specific parameters displayed in the module configuration screen.

Reference

The available parameters for each analog input module are as follows (parameters indicated in bold characters are part of the default configuration).

Parameter	**BMX AMI 0410**	**BMX AMI 0800**	**BMX AMI 0810**
Number of input channels	4	8	8
Channel used (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Scan Cycle	**Normal** Fast	**Normal** Fast	**Normal** Fast
Range	**+/-10 V** 0..0.10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA	**+/-10 V** 0..10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA	**+/-10 V** 0..10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA
Filter	**0**..6	**0**..6	**0**..6
Display	**%..** / User	**%..** / User	**%..** / User
Task associated to Channel	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST
Group of channels affected by the task change	2 contiguous channels	2 contiguous channels	2 contiguous channels
Rejection	-	-	-
Wiring Control (1)	-	-	-
Cold junction compensation: channels 0-3	N/A	N/A	N/A
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Legend: (1) This parameter is available as a checkbox.			

Parameter	BMX AMI 0410	BMX AMI 0800	BMX AMI 0810
Lower Threshold Range Overflow (1)	-11,400	-11,400	-11,400
Upper Threshold Range Overflow (1)	11,400	11,400	11,400
Legend: (1) This parameter is available as a checkbox.			

Parameter	BMX AMM 0600	BMX ART 0414	BMX ART 0814
Number of input channels	4	4	8
Channel used (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Scan Cycle	**Normal** Fast	-	-
Range	**+/-10 V** 0..0.10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA	**Thermo K** Thermocouple B Thermocouple E Thermo J Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U 0..400 Ohms 0..4000 Ohms Pt100 IEC/DIN Pt1000 IEC/DIN Pt100 US/JIS Pt1000 US/JIS Cu10 Copper Ni100 IEC/DIN Ni1000 IEC/DIN +/- 40 mV +/- 80 mV +/- 160 mV +/- 320 mV +/- 640 mV +/- 1.28 V	**Thermo K** Thermocouple B Thermocouple E Thermo J Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U 0..400 Ohms 0..4000 Ohms Pt100 IEC/DIN Pt1000 IEC/DIN Pt100 US/JIS Pt1000 US/JIS Cu10 Copper Ni100 IEC/DIN Ni1000 IEC/DIN +/- 40 mV +/- 80 mV +/- 160 mV +/- 320 mV +/- 640 mV +/- 1.28 V
Filter	**0**..6	**0**..6	**0**..6
Legend: (1) This parameter is available as a checkbox.			

Parameter	BMX AMM 0600	BMX ART 0414	BMX ART 0814
Display	**%..** / User	**1/10 °C** / 1/10 °F / %.. / User	**1/10 °C** / 1/10 °F / %.. / User
Task associated to Channel	**MAST** / FAST	**MAST**	**MAST**
Group of channels affected by the task change	2 contiguous channels	2 contiguous channels	2 contiguous channels
Rejection	-	**50 Hz** / 60 Hz	**50 Hz** / 60 Hz
Wiring Control (1)	-	Active / **Inactive**	Active / **Inactive**
Cold junction compensation: channels 0-3	N/A	• Internal by TELEFAST, • External by PT100.	• Internal by TELEFAST, • External by PT100, • Using the CJC values of channels 4/7 for channels 0/3.
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Lower Threshold Range Overflow (1)	-11,400	-2,680	-2,680
Upper Threshold Range Overflow (1)	11,400	13,680	13,680
Legend: (1) This parameter is available as a checkbox.			

Parameters for Analog Output Modules

At a Glance

The analog output module includes channel-specific parameters displayed in the module configuration screen.

Reference

The following table shows the available parameters (parameters indicated in bold characters are part of the default configuration).

Module	**BMX AMO 0210**	**BMX AMO 0410**	**BMX AMO 0802**	**BMX AMM 0600**
Number of output channels	2	4	8	2
Range	**+/-10 V** 0...20 mA 4...20 mA	**+/-10 V** 0...20 mA 4...20 mA	0...20 mA 4...20 mA	**+/-10 V** 0...20 mA 4...20 mA
Task associated to Channel	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST
Group of channels affected by the task change	All channels	All channels	All channels	All channels
Fallback	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Wiring check (1)	Active / **Inactive**	Active / **Inactive**	Active / **Inactive**	Active / **Inactive**
Legend: (1) This parameter is available as a checkbox.				

12.3 Entering Configuration Parameters Using Unity Pro

Subject of this Section

This section presents the entry of various configuration parameters for analog input/output channels using Unity Pro.

NOTE: For the communication between the channels and the CPU there is the logical nodes. Each logical node includes two channels. So when you modify the configuration of analog modules, the new parameters are applied for both channels of the logical node, Unity messages will inform you of this modification.

What Is in This Section?

This section contains the following topics:

Selecting the Range for an Analog Module's Input or Output

At a Glance

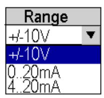
This parameter defines the range for the input or output channel.

Depending on the type of module, the input/output range may be:

- voltage
- current
- a thermocouple
- a RTD

Procedure

The procedure to define the range assigned to an analog module's channels is as follows.

Step	Procedure
1	Access the hardware configuration screen for the appropriate module
2	In the range column, click on the arrow of the pull-down menu pertaining to the channel you wish to configure **Results** : The following list appears. 
3	Select the appropriate range
4	Validate the change by clicking **Edit** →**Validate**

Selecting a Task Associated to an Analog Channel

At a Glance

This parameter defines the task through which the acquisition of inputs and the update of outputs are performed.

Depending on the type of module, the task is defined for a series of 2 or 4 contiguous channels.

The possible choices are as follows:

- the **MAST** task
- the **FAST** task

NOTE: The BMX ART 0414/0814 modules run only in Mast task.

⚠ WARNING

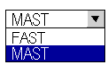
UNEXPECTED EQUIPMENT OPERATION

Do not assign more than 2 analog modules to the **FAST** task (each with all four channels in use). Using more than 2 modules may trigger system timing conflicts.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Procedure

The procedure to define the type of task assigned to an analog module's channels is as follows:

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	For the individual channel or group of channels you wish to configure, click on the **Task** pull-down menu in the **General Parameters** area. **Result**: The following scrolldown list appears: 
3	Select the appropriate task.
4	Validate the change by clicking **Edit** →**Validate**.

Selecting the Input Channel Scan Cycle

At a Glance

This parameter defines the input channel scan cycle for analog modules.

The input scan cycle may be:

- **Normal**: Channels are sampled within the time period specified in the module's characteristics.
- **Fast**: Only those inputs declared to be **In Use** are sampled. The scan cycle is therefore determined by the number of channels in use and by the time period allocated for scanning one channel.

Input channel registers are updated at the beginning of the task to which the module is assigned.

NOTE: The **Normal** / **Fast** and **In Use** cycle parameters cannot be edited in online mode if the project has been transferred to the PLC with the default values specified for these parameters (i.e. Normal cycle and All channels in use).

Instructions

The following table provides step-by-step instructions allowing you to define the scan cycle assigned to an analog module's inputs.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	For the group of input channels you wish to configure, check the appropriate box (**Normal** or **Fast**) for the **Cycle** field of the **General Parameters** area. **Result**: The selected scan cycle will be assigned to the channels.
3	Validate the change by clicking **Edit** →**Validate**.

Selecting the Display Format for a Current or Voltage Input Channel

At a Glance

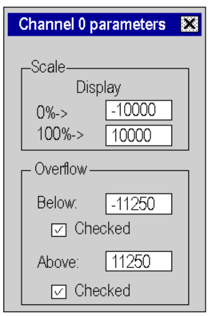
This parameter defines the display format for the measurement of an analog module channel whose range is configured for voltage or current.

The display format may be:

- standardized (**%..**):
  - unipolar range: 0 to +10,000
  - bipolar range : -10,000 to +10,000
- user-defined (**User**).

Procedure

The following table provides step-by-step instructions defining the display scale assigned to an analog module channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Result** : The **Channel Parameters** dialog box appears.  **Note**: The display modification change only concerns the **Scale** area. The **Overflow** area enables the modification of the overflow control *(see page 224)*.
4	Type in the values to be assigned to the channel in the two **Display** boxes situated in the **Scale** zone.
5	Confirm your changes by closing the dialog box **Note**: If default values have been selected (standardized display), the corresponding cell in the **Scale** column displays **%...** Otherwise it will show **User** (user display).
6	Validate the change by clicking **Edit** →**Validate**.

Selecting the Display Format for a Thermocouple or RTD Input Channel

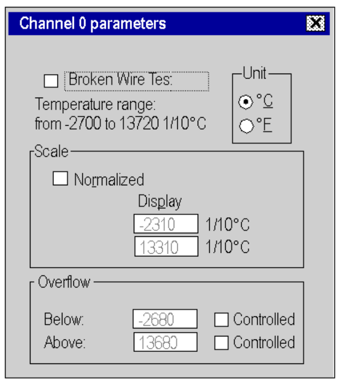
At a Glance

This parameter defines the display format for the measurement of an analog module channel whose range is configured as Thermocouple or RTD .

The available display formats are degrees Celsius (centigrade) or Fahrenheit, with the possibility of short-circuit or open circuit notification.

Procedure

The procedure for defining the display scale assigned to an analog module channel whose range is configured as a Thermocouple or RTD is as follows:

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Results** : The **Channel Parameters** dialog box appears. 
4	Check the **Broken Wire Test** box is you want to activate this function.
5	Select the temperature unit by checking ° **C** or ° **F**.
6	Check the **Standardized** box for a standardized display.
7	Validate the choice by closing the dialog box.
8	Validate the change by clicking **Edit** →**Validate**.

Selecting the Input Channels' Filter Value

At a Glance

This parameter defines the type of filtering for the input channel selected for analog modules (see *Measurement Filtering, page 59*).

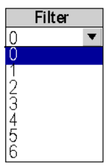
The available filtering values are:

- **0**: No filtering
- **1** and **2**: Low filtering
- **3** and **4**: Medium filtering
- **5** and **6**: High filtering

NOTE: Filtering is taken into account in both fast scan and normal cycles.

Procedure

The following table provides instructions for defining the filter value assigned to input channels for analog modules.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	In the **Filter** column, click on the arrow of the pull-down menu pertaining to the channel you wish to configure. **Results**: the pulldown menu appears. 
3	Select the filter value you wish to assign to the selected channel.
4	Validate the change by clicking **Edit** →**Validate**.

Selecting Input Channel Usage

At a Glance

A channel is declared to be "In Use" in a task when the measured values are "sent back" to the task assigned to the channel in question.

If a channel is not in use, the corresponding line is grayed out, the 0 value is sent back to the application program, and status indications specified for this channel (range overflow, etc.) are inactive.

Instructions

The following table provides specific instructions for modifying the usage status of a channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **In Use** column for the channel you wish to modify, then select or deselect the channel.
3	Validate the change by clicking **Edit** →**Validate**.

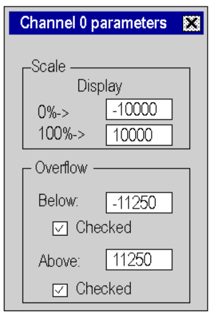
Selecting the Overflow Control Function

At a Glance

Overflow Control is defined by a monitored or unmonitored lower threshold, and by a monitored or unmonitored upper threshold.

Procedure

The procedure for modifying the Overflow Control parameters assigned to an analog module channel is as follows.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Results** : The **Channel Parameters** dialog box appears. 
4	Check the **Checked** box of the **Underflow** field to specify an underflow threshold.
5	Check the **Checked** box of the **Overflow** field to specify an overflow threshold.
6	Confirm your changes by closing the dialog box
7	Validate the change by clicking **Edit** →**Validate**.

Overflow Flags

If under/overflow control is required, indications are provided by the following bits.

Bit Name	Flag (when = 1)
%IWr.m.c.1.5	The value being read falls within the Lower Tolerance Area.
%IWr.m.c.1.6	The value being read falls within the Upper Tolerance Area.
%IWr.m.c.2.1	If over/underflow control is required, this bit indicates that the value currently read falls within one of the two unauthorized ranges: ● %MWr.m.c.3.6 denotes an underflow ● %MWr.m.c.3.7 denotes an overflow
%Ir.m.ERR	Channel Error.

Selecting the Cold Junction Compensation

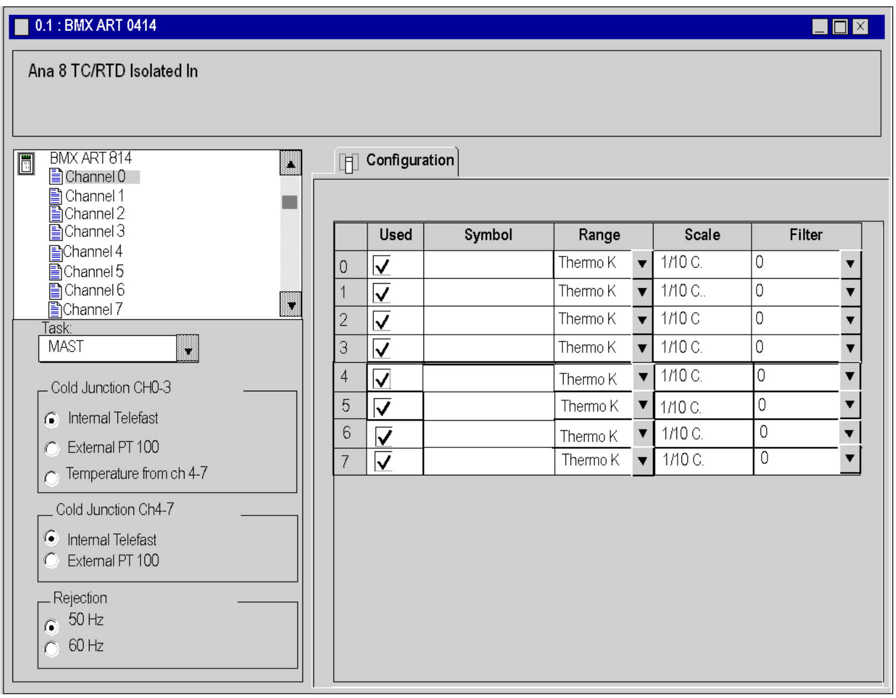
At a Glance

This function is available on the BMX ART 0414/814 analog input modules. It is carried out either by TELEFAST or by a Pt100 probe. An internal compensation by TELEFAST is proposed by default.

BMX ART 0414/0814 Module

The procedure for modifying the cold junction compensation of the BMX ART 0414/814 modules is as follows.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the Internal by TELEFAST, the External by Pt100 or the Temperature from Ch4-7 bloc box in the Cold Junction Channel 0-3 field.
3	Validate the change with **Edit** →**Validate**.



Selecting the Fallback Mode for Analog Outputs

At a Glance

This parameter defines the behavior adopted by outputs when the PLC switches to STOP or when there is a communication error.

The possible behavior types are:

- **Fallback**: Outputs are set to an editable value between -10,000 and +10,000 (0 is the default).
- **Maintain value**: Outputs remain in the state they were in before the PLC switched to STOP.

Instructions

The following table provides instructions for defining the fallback behavior assigned to outputs of analog modules.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the box in the cell of the **Fallback** column for the output you want to configure.
3	Enter the desired value in the cell of the **Fallback Value** column. **Result**: The selected fallback mode will be assigned to the selected output.
4	To select the **Maintain** mode instead, uncheck the box in the cell of the **Fallback** column for the channel in question. **Result**: The maintain value behavior will be assigned to the selected output.
5	Validate the change by clicking **Edit** →**Validate**.

IODDTs and Device DDTs for Analog Modules

13

Subject of this Chapter

This chapter presents the various language objects, IODDTs and Device DDTs associated with analog input/output modules.

In order to avoid several simultaneous explicit exchanges for the same channel, it is necessary to test the value of the word EXCH_STS (`%MWr.m.c.0`) of the IODDT associated to the channel before to call any EF using this channel.

What Is in This Chapter?

This chapter contains the following topics:

Detailed Description of T_ANA_IN_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_IN_BMX`-type IODDT objects applicable to **BMX AMI 0410**, **BMX AMI 0800** and **BMX AMI 0810**, and to **the inputs of the BMX AMM 600 mixed module**.

Input Measurement

The analog input measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The `%Ir.m.c.ERR` error bit is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

MEASURE_STS Measurement Status Word

The meaning of the `MEASURE_STS` (%IWr.m.c.1) measurement status word bits is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ALIGNED	BOOL	R	Aligned channel.	%IWr.m.c.1.0
CH_FORCED	BOOL	R	Forced channel.	%IWr.m.c.1.1
LOWER_LIMIT	BOOL	R	Measurement within lower tolerance area.	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement within upper tolerance area.	%IWr.m.c.1.6
INT_OFFSET_ERROR	BOOL	R	Internal offset error.	%IWr.m.c.1.8
INT_REF_ERROR	BOOL	R	Internal reference error.	%IWr.m.c.1.10
POWER_SUP_ERROR	BOOL	R	Power supply error.	%IWr.m.c.1.11
SPI_COM_ERROR	BOOL	R	SPI communication error.	%IWr.m.c.1.12

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Read error for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during command parameter exchange.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Status: CH_FLT

The following table explains the meaning of the `CH_FLT` (%MWr.m.c.2) status word bits. Reading is performed by a `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor connection error.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
CH_ERR_RPT	BOOL	R	Channel error report.	%MWr.m.c.2.2
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application error (adjustment or configuration error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.3.0
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.3.2
INT_OFFS_FLT	BOOL	R	Internal calibration offset error.	%MWr.m.c.3.3
INT_REF_FLT	BOOL	R	Internal calibration reference error.	%MWr.m.c.3.4
INT_SPI_PS_FLT	BOOL	R	Internal serial link or power supply error.	%MWr.m.c.3.5
RANGE_UNF	BOOL	R	Recalibrated channel or range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Aligned channel or range overflow.	%MWr.m.c.3.7

Command Controls

The following table explains the meaning of the COMMAND_ORDER (%MWr.m.c.4) status word bit. Reading is performed by a READ_STS;

Standard symbol	Type	Access	Meaning	Address
FORCING_UNFORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The table below presents the meaning of the %MWr.m.c.5, %MWr.m.c.8 and %MWr.m.c.9 words, as well as the threshold command words (%MWr.m.c.10 and %MWr.m.c.11). Queries used are those associated with parameters (READ_PARAM, WRITE_PARAM):

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FILTER_COEFF	INT	R/W	Value of filter coefficient.	%MWr.m.c.8
ALIGNMENT_OFFSET	INT	R/W	Alignment offset value.	%MWr.m.c.9

NOTE: In order to force a channel, you have to use the WRITE_CMD (%MWr.m.c.5) instruction and set the %MWr.m.c.4.13 bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the %MWr.m.c.4.13 bit to 0.

Detailed Description of T_ANA_IN_T_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_IN_T_BMX`-type IODDT objects applicable to **BMX ART 0414/0814** analog input modules.

Input Measurement

The analog input measurement object is as follows:

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The %Ir.m.c.ERR error bit is as follows:

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

MEASURE_STS Measurement Status Word

The various meanings of the `MEASURE_STS` (%IWr.m.c.1) measurement status word bits are as follows:

Standard symbol	Type	Access	Meaning	Address
CH_ALIGNED	BOOL	R	Aligned channel.	%IWr.m.c.1.0
CH_FORCED	BOOL	R	Forced channel.	%IWr.m.c.1.1
LOWER_LIMIT	BOOL	R	Measurement within lower tolerance area.	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement within upper tolerance area.	%IWr.m.c.1.6
INT_OFFSET_ERROR	BOOL	R	Internal offset error.	%IWr.m.c.1.8
INT_REF_ERROR	BOOL	R	Internal reference error.	%IWr.m.c.1.10
POWER_SUP_ERROR	BOOL	R	Power supply error.	%IWr.m.c.1.11
SPI_COM_ERROR	BOOL	R	SPI communication error.	%IWr.m.c.1.12

Cold Junction Compensation

The value of the cold junction compensation is as follows:

Standard symbol	Type	Access	Meaning	Address
CJC_VALUE	INT	R	Cold junction compensation value (1/10° C).	%IWr.m.c.2

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows:

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows:

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Read error for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during command parameter exchange.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Status: CH_FLT

The following table explains the meaning of the `CH_FLT` (%MWr.m.c.2) status word bits. Reading is performed by a `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor connection error.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
CH_ERR_RPT	BOOL	R	Channel error report.	%MWr.m.c.2.2
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application error (adjustment or configuration error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.3.0
COLD_JUNCTION_FLT	BOOL	R	Cold junction compensation error.	%MWr.m.c.3.1
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.3.2
INT_OFFS_FLT	BOOL	R	Internal calibration offset error.	%MWr.m.c.3.3
INT_REF_FLT	BOOL	R	Internal calibration reference error.	%MWr.m.c.3.4
INT_SPI_PS_FLT	BOOL	R	Internal serial link or power supply error.	%MWr.m.c.3.5
RANGE_UNF	BOOL	R	Range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Range overflow.	%MWr.m.c.3.7

Command Controls

The following table explains the meaning of the COMMMAND_ORDER (%MWr.m.c.4) status word bit. Reading is performed by a READ_STS:

Standard symbol	Type	Access	Meaning	Address
FORCING__UNFORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The table below presents the meaning of the %MWr.m.c.5, %MWr.m.c.8 and %MWr.m.c.9 status words. Queries used are those associated with parameters (READ_PARAM, WRITE_PARAM).

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FILTER_COEFF	INT	R/W	Value of filter coefficient.	%MWr.m.c.8
ALIGNMENT_OFFSET	INT	R/W	Alignment offset value.	%MWr.m.c.9

NOTE: In order to force a channel, you have to use the WRITE_CMD (%MWr.m.c.5) instruction and set the %MWr.m.c.4.13 bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the %MWr.m.c.4.13 bit to 0.

Detailed Description of T_ANA_OUT_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_OUT_BMX`-type IODDT objects applicable to the **BMX AMO 0210**, **BMX AMO 0410** and **BMX AMO 0802** analog output modules and the outputs of the **BMX AMM 600** mixed module.

Value of the Output

The analog output measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog output measurement.	%QWr.m.c.0

%Ir.m.c.ERR error bit

The %Ir.m.c.ERR error bit is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Value Forcing

The value forcing bit is as follows.

Standard symbol	Type	Access	Meaning	Address
FORCING_VALUE	INT	R	Forcing of the value.	%IWr.m.c.0

Channel forcing indicator.

The meaning of the forcing control bits of the channel (%IWr.m.c.1) is as follows.

Standard symbol	Type	Access	Meaning	Address
CHANNEL_FORCED	BOOL	R	Forcing of the channel.	%MWr.m.c.1.1

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows:

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows:

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Read error for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during command parameter exchange.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Status: CH_FLT

The following table explains the meaning of the `CH_FLT` (%MWr.m.c.2) status word bits. Reading is performed by a `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
ACT_WIRE_FLT	BOOL	R	Actuator wire open or short.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
SHORT_CIRCUIT	BOOL	R	Short-circuit.	%MWr.m.c.2.2
CAL_PRM_FLT	BOOL	R	Calibration parameters not configured.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application error (adjustment or configuration error).	%MWr.m.c.2.7
ALIGNED_CH	BOOL	R	Aligned channels.	%MWr.m.c.3.0
INT_CAL_FLT	BOOL	R	Calibration parameters not defined.	%MWr.m.c.3.2
INT_PS_FLT	BOOL	R	Internal power supply error.	%MWr.m.c.3.3
INT_SPI_FLT	BOOL	R	Serial link error.	%MWr.m.c.3.4
RANGE_UNF	BOOL	R	Range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Range overflow.	%MWr.m.c.3.7

Command Control

The following table explains the meaning of the `COMMAND_ORDER` (%MWr.m.c.4) status word bit. Reading is performed by a `READ_STS`:

Standard symbol	Type	Access	Meaning	Address
FORCING_UNFORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The following table shows the meaning of the words %MWr.m.c.5 to %MWr.m.c.8. The requests used are those associated with the parameters (`READ_PARAM` and `WRITE_PARAM`).

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FALLBACK	INT	R/W	Fallback value.	%MWr.m.c.7
ALIGNMENT	INT	R/W	Alignment value.	%MWr.m.c.8

NOTE: In order to force a channel, you have to use the `WRITE_CMD (%MWr.m.c.5)` instruction and set the `%MWr.m.c.4.13` bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the `%MWr.m.c.4.13` bit to 0.

Detailed Description of T_ANA_IN_GEN-type IODDT Objects

At a Glance

The tables below present the T_ANA_IN_GEN-type IODDT objects that are applicable to the BMX AMI 0410, BMX AMI 0800 and BMX AMI 0810 input modules, to the inputs of the BMX AMM 600 mixed module and to the BMX ART 0414/0814 analog input module.

Input Measurement

The analog input measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The %Ir.m.c.ERR error bit is as follows:

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of T_ANA_OUT_GEN-type IODDT Objects

At a Glance

The following tables describe the T_ANA_IN_GEN-type IODDT objects applicable to the BMX AMO 0210, BMX AMO 0410 and BMX AMO 0802 analog output modules and to the output of the BMX AMM 600 mixed module.

Input Measurement

The analog output measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog output measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The %Ir.m.c.ERR error bit is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Details of the Language Objects of the IODDT of Type T_GEN_MOD

Introduction

All the modules of Modicon M340 PLCs have an associated IODDT of type T_GEN_MOD.

Observations

In general, the meaning of the bits is given for bit status 1. In specific cases an explanation is given for each status of the bit.

Some bits are not used.

List of Objects

The table below presents the objects of the IODDT.

Standard Symbol	Type	Access	Meaning	Address
MOD_ERROR	BOOL	R	Module detected error bit	%Ir.m.MOD.ERR
EXCH_STS	INT	R	Module exchange control word	%MWr.m.MOD.0
STS_IN_PROGR	BOOL	R	Reading of status words of the module in progress	%MWr.m.MOD.0.0
EXCH_RPT	INT	R	Exchange report word	%MWr.m.MOD.1
STS_ERR	BOOL	R	Event when reading module status words	%MWr.m.MOD.1.0
MOD_FLT	INT	R	Internal detected errors word of the module	%MWr.m.MOD.2
MOD_FAIL	BOOL	R	module inoperable	%MWr.m.MOD.2.0
CH_FLT	BOOL	R	Inoperative channel(s)	%MWr.m.MOD.2.1
BLK	BOOL	R	Terminal block incorrectly wired	%MWr.m.MOD.2.2
CONF_FLT	BOOL	R	Hardware or software configuration anomaly	%MWr.m.MOD.2.5
NO_MOD	BOOL	R	Module missing or inoperative	%MWr.m.MOD.2.6
EXT_MOD_FLT	BOOL	R	Internal detected errors word of the module (Fipio extension only)	%MWr.m.MOD.2.7
MOD_FAIL_EXT	BOOL	R	Internal detected error, module unserviceable (Fipio extension only)	%MWr.m.MOD.2.8
CH_FLT_EXT	BOOL	R	Inoperative channel(s) (Fipio extension only)	%MWr.m.MOD.2.9
BLK_EXT	BOOL	R	Terminal block incorrectly wired (Fipio extension only)	%MWr.m.MOD.2.10
CONF_FLT_EXT	BOOL	R	Hardware or software configuration anomaly (Fipio extension only)	%MWr.m.MOD.2.13
NO_MOD_EXT	BOOL	R	Module missing or inoperative (Fipio extension only)	%MWr.m.MOD.2.14

Analog Device DDT Names

Introduction

This topic describes the Unity Pro **Analog Device DDT**.

The default device DDT name contains the following information:
- module input and or output (***X*** symbol)
- module insertion number (***#*** symbol).

Example: `MOD_ANA_`***`x`***`_`***`#`***

The default device DDT type contains the following information:
- platform with:
  - M for Modicon M340
  - U for unified structure between M340 and Quantum
- device type (ANA for analog)
- function (STD for standard)
  - STD for standard
  - TEMP for temperature
- direction:
  - IN
  - OUT
- max channel (2, 4,8)

Example: For a Modicon M340 with 4 standard inputs and 2 outputs: T_U_ANA_STD_IN_4_OUT_2

Adjustment Parameter limitation

Adjustment parameters cannot be changed from the PLC application during operation (no support of `READ_PARAM`, `WRITE_PARAM`, `SAVE_PARAM`, `RESTORE_PARAM`).

Modifying the adjustment parameters of a channel from Unity Pro during a CCOTF operation causes the involved channel to be reinitialized.

The concerned analog input parameters are:
- `FILTER_COEFF`
  Value of filter coefficient
- `ALIGNMENT_OFFSET`
  Alignment offset value
- `THRESHOLD0`
  Low threshold value
- `THRESHOLD1`
  High threshold value

The concerned Analog Output parameters are:
- `FALLBACK`
  Fallback Value
- `ALIGNMENT`
  Alignment value

List of Implicit Device DDT

The following table shows the list of Modicon M340 devices and their corresponding device DDT name and type:

Device DDT Name	Device DDT Type	Modicon M340 Devices
MOD_ANA_4_#	T_U_ANA_STD_IN_4	BMX AMI 0410
MOD_ANA_8_#	T_U_ANA_STD_IN_8	BMX AMI 0810 BMX AMI 0800
MOD_ANA_2_#	T_U_ANA_STD_OUT_2	BMX AMO 0210
MOD_ANA_4_#	T_U_ANA_STD_OUT_4	BMX AMO 0410
MOD_ANA_8_#	T_U_ANA_STD_OUT_8	BMX AMO 0802
MOD_ANA_6_#	T_U_ANA_STD_IN_4_OUT_2	BMX AMM 0600
MOD_ANA_4_#	T_U_ANA_TEMP_IN_4	BMX ART 0414
MOD_ANA_8_#	T_U_ANA_TEMP_IN_8	BMX ART 0814

Implicit Device DDT Instances Description

The following table shows the `T_U_ANA_STD_IN_x` and the `T_U_ANA_STD_OUT_y` status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte of the module	read
ANA_CH_IN	ARRAY [0...(x-1)] of `T_U_ANA_STD_CH_IN`	array of structure	
ANA_CH_OUT	ARRAY [0...(y-1)] of `T_U_ANA_STD_CH_OUT`	array of structure	

The following table shows the `T_U_ANA_STD_IN_x_OUT_x` status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte of the module	read
ANA_CH_IN	ARRAY [0...(x-1)] of `T_U_ANA_STD_CH_IN`	array of structure	
ANA_CH_OUT	ARRAY [x...(x+y-1)] of `T_U_ANA_STD_CH_OUT`	array of structure	

The following table shows the `T_U_ANA_TEMP_IN_x` status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte of the module	read
ANA_CH_IN	ARRAY [[0...(x-1)] of `T_U_ANA_TEMP_CH_IN`	array of structure	

The following table shows the `T_U_ANA_STD_CH_IN[0...x-1]` structure status word bits:

Standard Symbol		Type	Bit	Meaning	Access
FCT_TYPE		WORD		0 = channel is not used	read
				1 = channel is used	
CH_HEALTH		BOOL		0 = channel is inactive	read
				1 = channel is active	
CH_WARNING		BOOL		0 = no detected warning on the channel	read
				1 = a detected warning on the channel	
ANA		STRUCT		`T_U_ANA_VALUE_IN`	read
MEASURE_STS [INT]	CH_ALIGNED	BOOL	0	aligned channel	read
	LOWER_LIMIT	BOOL	5	measurement within lower tolerance area	read
	UPPER_LIMIT	BOOL	6	measurement within upper tolerance area	read
	INT_OFFSET_ERROR	BOOL	8	internal offset detected error	read
	IN_REF_ERROR	BOOL	10	internal reference detected error	read
	POWER_SUP_ERROR	BOOL	11	power supply detected error	read
	SPI_COM_ERROR	BOOL	12	SPI communication detected error	read

The following table shows the `T_U_ANA_STD_CH_OUT`[0...y-1] status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte of the module	read
ANA_CH_OUT	ARRAY [0...y-1] of `T_U_ANA_VALUE_OUT`	array of structure	

The following table shows the T_U_ANA_VALUE_IN[0...x-1] and T_U_ANA_VALUE_OUT[0...y-1] structure status word bits:

Standard Symbol	Type	Bit	Meaning	Access
VALUE	INT		if FORCE_CMD = 1 then VALUE = FORCED_VALUE	read[1]
			if FORCE_CMD = 0 then VALUE = TRUE_VALUE	
FORCED_VALUE	INT		forced value of the channel	read / write
FORCE_CMD	BOOL		0 = Un-force command	read / write
			1 = force command	
FORCE_STATE	BOOL		0 = value is not forced	read
			1 = value is forced	
TRUE_VALUE[2]	INT		True value of the channel (from the sensor)	read

1 VALUE of the T_U_ANA_VALUE_OUT structure word can be accessed in read / write

2 TRUE_VALUE of the T_U_ANA_VALUE_OUT is the value calculated from the application.

The following table shows the T_U_ANA_TEMP_CH_IN[0...x-1] structure status word bits:

Standard Symbol	Type	Bit	Meaning	Access
FCT_TYPE	WORD		0 = channel is not used	read
			1 = channel is used	
CH_HEALTH	BOOL		0 = channel is inactive	read
			1 = channel is active	
CH_WARNING	BOOL		0 = no detected warning on the channel	read
			1 = a detected warning on the channel	
ANA	STRUCT		T_U_ANA_VALUE_IN	read
MEASURE_STS	INT		measurement status	read
CJC_VALUE	INT		Cold junction compensation value (1/10° C)	read

Explicit DDT Instances Description

Explicit exchanges (Read Status) - only applicable to Modicon M340 I/O channels - are managed with READ_STS_QX EFB instance:

- Targeted channel address (ADDR) can be managed with ADDMX EF (connect ADDMX OUT to ADDR)
- READ_STS_QX output parameter (STATUS) can be connected to a T_M_xxx_yyy_CH_STS DDT instance (variable created manually), where:
  - xxx represents the device type
  - yyy represents the function

  Example: T_U_ANA_TEMP_CH_STS

The following table shows the T_U_ANA_STD_CH_STS and T_U_ANA_TEMP_CH_STS status word bits:

Type	Type	Access
STRUCT	T_U_ANA_STD_CH_STS	
STRUCT	T_U_ANA_TEMP_CH_STS	

The following table shows the T_U_ANA_STD_CH_STS and T_U_ANA_TEMP_CH_STS structure status word bits:

Standard Symbol		Type	Bit	Meaning	Access
CH_FLT [INT]	SENSOR_FLT	BOOL	0	detected sensor faults	read
	RANGE_FLT	BOOL	1	detected range fault	read
	CH_ERR_RPT	BOOL	2	channel detected error report	read
	INTERNAL_FLT	BOOL	4	internal detected error: module out of order	read
	CONF_FLT	BOOL	5	detected configuration fault: different hardware and software configurations	read
	COM_FLT	BOOL	6	problem communicating with the PLC	read
	APPLI_FLT	BOOL	7	detected application fault	read
CH_FLT_2 [INT]	NOT_READY	BOOL	0	Channel not ready	read
	COLD_JUNCTION_FLT[1]	BOOL	1	Cold junction compensation detected error	read
	CALIB_FLT	BOOL	2	detected calibration fault	read
	INT_OFFS_FLT	BOOL	3	detected internal offset error	read
	IN_REF_FLT	BOOL	4	detected internal reference fault	read
	INT_SPI_PS_FLT	BOOL	5	detected internal serial link or power supply error	read
	RANGE_UNF	BOOL	6	recalibrated channel or range underflow	read
	RANGE_OVF	BOOL	7	aligned channel or range overflow	read
1 COLD_JUNCTION_FLT is only available with T_U_ANA_TEMP_CH_STS					

Analog Device Ethernet Remote I/O Forcing Mode

Introduction

Input and output values of Modicon M340 analog modules can be forced through the device DDT value.

NOTE: Modicon M340 discrete modules values are forced using the `EBOOL` mechanism, refer to chapter ***Force Mode*** *(see Unity Pro, Operating Modes)*.

Forcing input and output values in a running controller can have serious consequences to the operation of a machine or process. Only those who understand the implications in the controlling logic, and who understand the consequences of forced I/O on the machine or process, should attempt to use this function.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

You must have prior knowledge of the process, the controlled equipment and the modified behavior in Unity Pro before attempting to force analog inputs or outputs.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Modicon M340 Analog Device T_U_ANA_VALUE_•• Structure

The following table shows the content of analog devices DDT *(see page 242)* type used to force a value:

Standard Symbol	Type	Meaning
VALUE	INT	Channel value. It represents the value used in the application and is either the FORCED_VALUE or the TRUE_VALUE depending on the FORCED_STATE.
FORCED_VALUE	INT	Value applied to an output or interpreted as an input during forcing. If FORCED_STATE = 1 then VALUE = FORCED_VALUE
FORCE_CMD	BOOL	Parameter used to force or unforce an analog output or input value
FORCED_STATE	BOOL	Forcing status: • 0: value is not forced • 1: value is forced
TRUE_VALUE	INT	Represents the true value of the analog output or input whatever the state of the forcing command

Forcing a Value with the Animation Tables

To force a DDT value in an animation table proceed as follows:

Step	Action
1	Select the chosen analog channel.
2	Set the FORCED_VALUE parameter value of the selected channel to the chosen value, for details on how to set a value, refer to chapter ***Modification Mode*** *(see Unity Pro, Operating Modes)*.
3	Set the FORCE_CMD parameter to 1.
4	**Result**: ● Check that forcing is applied: FORCED_STATE must be equal to 1 ● VALUE = FORCED_VALUE

Unforcing a Value with the Animation Tables

To unforce a DDT value in an animation table proceed as follows:

Step	Action
1	Select the chosen analog channel.
2	Set the FORCE_CMD parameter to 0.
3	**Result**: ● Check that forcing is released: FORCED_STATE must be equal to 0 ● VALUE = TRUE_VALUE

Analog Module Debugging

14

Subject of this Chapter

This chapter describes the debugging aspect of the analog modules.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the Debug Function of an Analog Module

Introduction

This function is only accessible in online mode. For each input/output module of the project, it can be used to:

- display measurements
- display the parameters of each channel (channel state, filtering value, etc.)
- access the diagnostics and adjustment of the selected channel (masking the channel, etc.)

The function also gives access to the module diagnostics in the case of an event.

Procedure

The procedure to access the **Debugging** function is as follows.

Step	Action
1	configure the module
2	transfer the application to the PLC
3	change to online mode
4	in the rack configuration screen, double-click on the module
5	select the **Debugging** tab

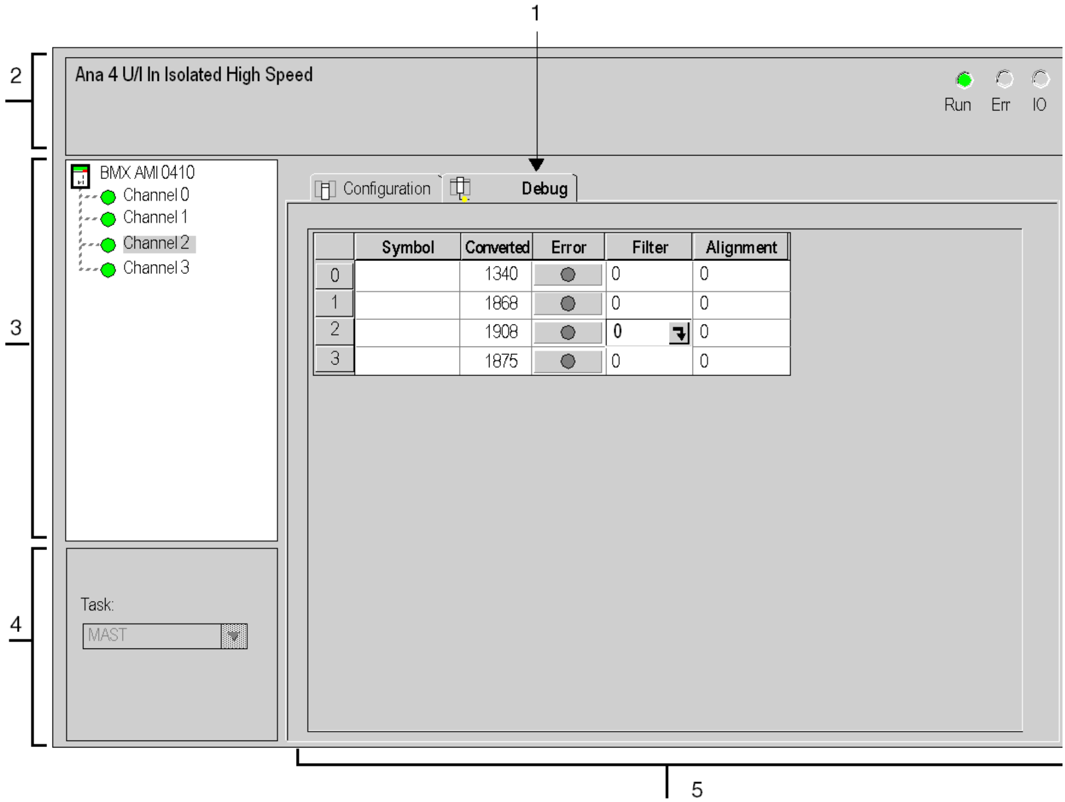
Description of the Analog Module Debug Screen

At a Glance

The Debug Screen displays, in real time, the current value and status for each of the selected module's channels.

Illustration

The figure below shows a sample debugging screen.



Description

The table below shows the different elements of the debug screen and their functions.

Address	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Debug** in this example). Each mode can be selected by the corresponding tab. The available modes are: ● **Debug** which can be accessed only in online mode. ● **Configuration**.
2	**Module** area	Specifies the shortened name of the module. In the same area there are 3 LEDs which indicate the status of the module in online mode: ● **RUN** indicates the operating status of the module, ● **ERR** indicates an internal detected error in the module, ● **I/O** indicates an event from outside the module or an application error.
3	**Channel** area	Is used: ● To select a channel. ● To display the **Symbol**, name of the channel defined by the user (using the variable editor).
4	**General parameters** area	Specifies the **MAST** or **FAST** task configured. This information cannot be modified.
5	**Viewing and control** area	Displays the value and status for each channel in the module in real-time. The symbol column displays the symbol associated with the channel when the user has defined this (from the variable editor). This area provides direct access to channel by channel diagnostics when these are inoperative (indicated by error column LED ,which turns red). ● Access to the settings of the filtering, alignment and fallback values of the outputs, ● To channel-by-channel diagnostics when channels have an error (indicated by the LED built into the diagnostics access button, which turns red).

NOTE: LEDs and commands not available appear grayed out.

Selecting the Adjustment Values for the Input Channels and Measurement Forcing

At a Glance

This function is used to modify the filter, alignment and forcing value of one or more channels of an analog module.

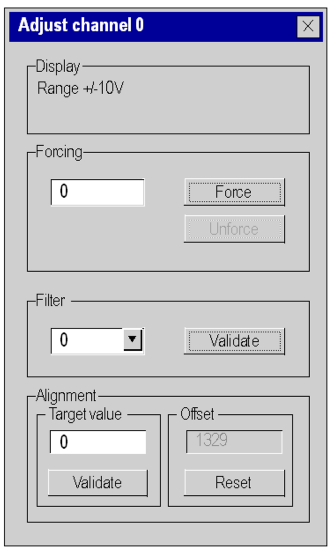
The available commands are:

- forcing
- filter
- alignment

To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel, in order toapply the parameters correctly.

Procedure

The table below summarizes the procedure for modifying the filter, forcing and alignment values.

Step	Action for a channel
1	Access the debug screen.
2	Select the channel to be modified in the **Display** zone and double-click in the corresponding box. **Result**: The **Adjust channel** dialog box appears. 

Step	Action for a channel
3	Click on the text field in the **Forcing** field. Enter the forcing value. Send the forcing order by clicking on the **Forcing** button.
4	Click on the drop-down menu in the **Filter** field, and define the new selected filter value. Confirm this selection by clicking **OK**.
5	In the **Alignment** field click on the text field and define the target value. Confirm this selection by clicking **OK**.
6	Close the **Adjust channel** dialog box. **Results**: The new filter, forcing or alignment value then appears in the box corresponding to the selected channel in the **Filter**, **Forcing** or **Alignment** column of the **Display** area.

Modification of Output Channels Adjustment Values

At a Glance

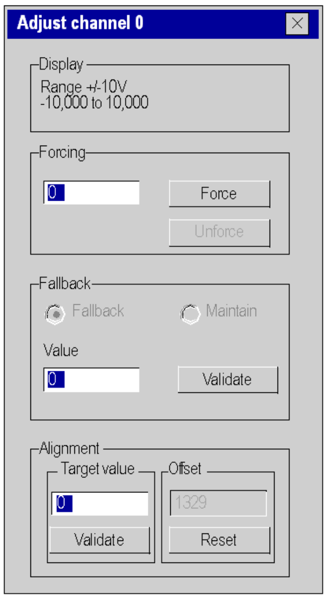
This function is used to modify the forcing, fallback and alignment values for one or several output channels of an analog module.

The available commands are:

- forcing
- fallback
- alignment

Procedure

The table below summarizes the procedure for modifying the values to be applied at the output channels:

Step	Action for a channel
1	Access the debug screen.
2	Select the channel in the **Display** zone and double-click in the corresponding box. **Result**: The **Adjust channel** dialog box appears. 

Step	Action for a channel
3	Click on the text field in the **Forcing** field of the **Adjust channel** dialog box. Enter the forcing value. Send the forcing order by clicking on the **Forcing** button.
4	Click on the box in the **Value** field of the **Fallback** dialog box and enter the new fallback value. Confirm this new value by clicking **OK**.
5	Click on the text field in the **Alignment** field of the **Adjust channel** dialog box and define the target value. Confirm this selection by clicking **OK**.
6	Close the **Adjust channel** dialog box.

Analog Module Diagnostics

15

Subject of this Chapter

This chapter describes the diagnostics aspect in the implementation of analog modules.

What Is in This Chapter?

This chapter contains the following topics:

Diagnostics of an Analog Module

At a Glance

The Module diagnostics function displays errors when they occur, classified according to category:

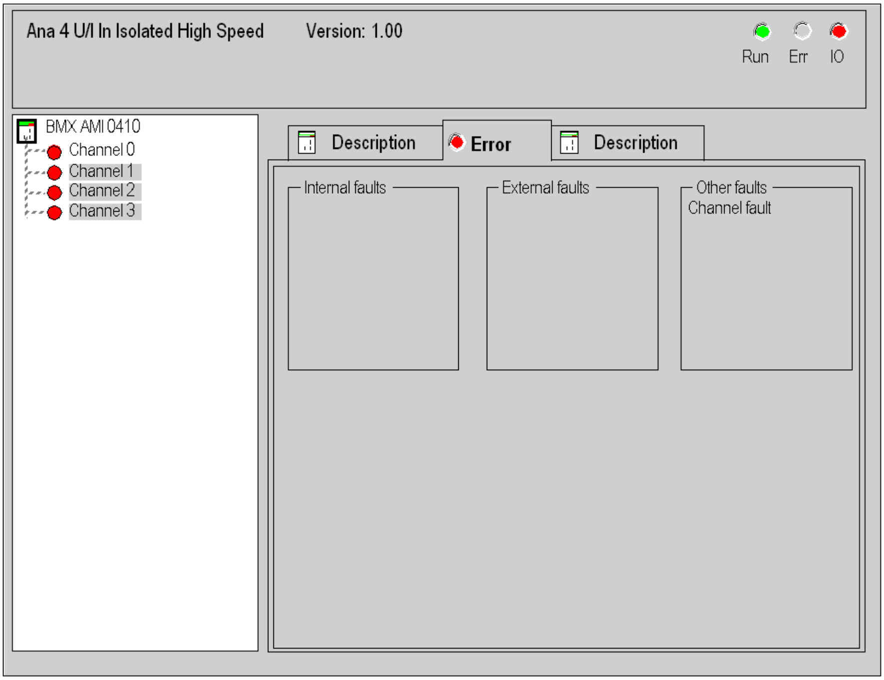
- **Internal detected error**:
  - module malfunction
  - self-testing error
- **External events**:
  - Wiring control (broken-wire, overload or short-circuit)
  - Under range/over range
- **Other errors**:
  - configuration error
  - module missing or off
  - inoperative channel

A module error is indicated by a number of LEDs changing to red, such as:

- in the rack-level configuration editor:
  - the LED of the rack number
  - the LED of the slot number of the module on the rack
- in the module-level configuration editor:
  - the **Err** and **I/O** LEDs, depending on the type of error
  - the **Channel** LED in the **Channel** field

Procedure

The table below shows the procedure for accessing the module Fault screen.

Step	Action
1	Open the module debugging screen.
2	Click on the module reference in the channel zone and select the **Fault** tab. **Result**: The list of module errors appears.  **Note:** It is not possible to access the module diagnostics screen if a configuration error, major breakdown error, or module missing error occurs. The following message then appears on the screen: " `The module is missing or different from that configured for this position.`"

Detailed Diagnostics by Analog Channel

At a Glance

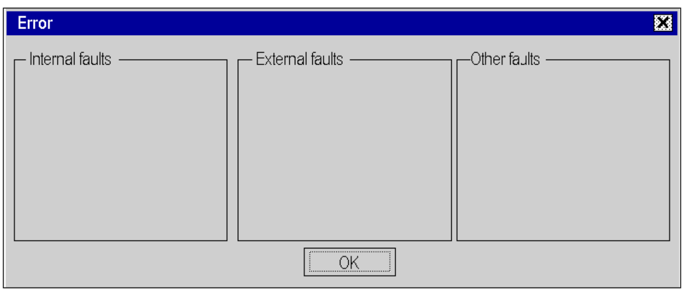
The channel Diagnostics function displays errors when they occur, classified according to category:

- **Internal errors**
  - inoperative channel
  - calibration error
- **External events**
  - sensor link event
  - range overflow/underflow
  - cold junction compensation error
- **Other errors**
  - configuration error
  - communication loss
  - application error
  - value outside range (output channel)
  - channel not ready

A channel error is indicated in the **Debug** tab when the  LED, located in the **Error** column, turns red.

Procedure

The table below shows the procedure for accessing the channel Fault screen.

Step	Action
1	Open the module debugging screen.
2	For the inoperative channel, click on the button  situated in the **Error** column. **Result**: The list of channel errors appears.  **Note:** Channel diagnostics information can also be accessed by program (instruction READ_STS).

Operating Modules from the Application

16

Subject of this Chapter

This chapter explains how to operate the analog input/output modules from an application.

What Is in This Chapter?

This chapter contains the following sections:

16.1 Access to the Measurements and Statuses

Subject of this Section

This section indicates how to configure an analog module in order to be able to access the input/outputs measurements and the various statuses.

What Is in This Section?

This section contains the following topics:

Addressing of the Analog Module Objects

At a Glance

The addressing of the main bit and word objects of the analog input/output modules depends upon:

- the rack address
- the physical position of the module in the rack
- the module channel number

NOTE: With Unity Pro 6.1 or later and Modicon M340 firmware 2.4 or later, you can access the modules either via topological or State RAM addresses.

Please refer to *Memory Tab (see Unity Pro, Operating Modes)* and *Topological/State RAM Addressing of Modicon M340 Analog Modules (see page 343)*.

Description

Addressing is defined in the following way.

%	**I, Q, M, K**	**X, W, D, F**	**r**	**.**	**m**	**.**	**c**	**.**	**i**	**.**	**j**
Symbol	Object type	Format	Rack		Module position		Channel no.		Rank		Word bit

The table below describes the different elements that make up addressing.

Family	**Element**	**Meaning**
Symbol	%	-
Object type	I Q	Image of the physical input of the module. Image of the physical output of the module. This information is exchanged automatically for each cycle of the task to which they are attached.
	M	Internal variable. This read or write information is exchanged at the request of the application.
	K	Internal constant. This configuration information is available as read only.
Format (size)	X	Boolean. For Boolean objects the X can be omitted.
	W	Single length.
	D	Double length.
	F	Floating point.
Rack address	r	Rack address.

Family	Element	Meaning
Module position	m	Module position number in the rack.
Channel no.	c	Channel no. 0 to 127 or MOD (MOD: channel reserved for managing the module and parameters common to all the channels).
Rank	i	Word rank. 0 to 127 or ERR (ERR: indicates an error in the word).
Word bit	j	Position of the bit in the word.

Examples

The table below shows some examples of analog object addressing.

Object	Description
%I1.3.MOD.ERR	Error information for the analog input module located in position 3 on rack 1.
%I1.4.1.ERR	Channel 1 error information for the analog input module located in position 4 on rack 1.
%IW1.2.2	Image word for the analog input 2 of the module located in position 2 on rack 1.
%QW2.4.1	Image word for the analog output 1 of the module located in position 4 on rack 2.

Module Configuration

At a Glance

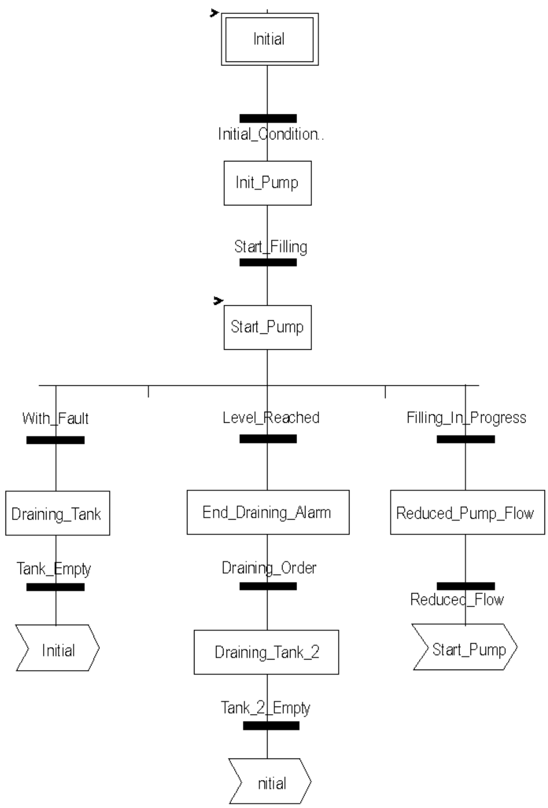
The application used here as an example manages liquid levels in a tank. The tank is filled by a pump and drained using a valve. The different levels of the tank are measured with sensors placed above the tank. The tank should not be filled with more than 100 liters of liquid.

Once the tank is full, the pump stops, and the operator drains the tank manually.

This application requires the use of a BMX AMI 0410 analog input module and a BMX AMO 0210 analog output module. This application may also require a BMX AMM 0600 input/output module.

Tank Management Grafcet

The application's grafcet is as follows:



Using the Measurements

We are going to configure the BMX_AMI_0410 analog input module so that we can retrieve the level of the liquid in the tank.

Step	Action
1	In the `Project browser` and in `Variables & FB instances`, double-click on `Elementary variables`.
2	Create the `INT`-type variable, `Level`.
3	In the `Address` column, enter the address associated with this variable. In our example, we consider that the sensor is connected to channel 0 of the BMX AMI 0410 module. This module is in turn connected to slot 1 of rack 0. We therefore have the following address: %IW0.1.0. Illustration: 

This variable can be used to check whether the level of liquid in the tank has reached maximum level.

To do this, the following line of code can be associated with the `Level_Reached` transition of the grafcet.

If the level of liquid in the tank reaches or exceeds the maximum level, the `Level_Reached` transition is enabled.

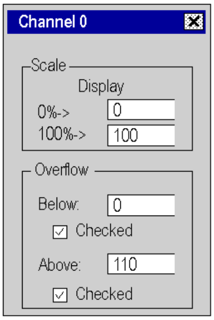
Using the Statuses

We will need to program the `With_fault` transition so that we can stop the pump in three cases:

- the maximum liquid level has been reached
- the pump has been stopped manually
- the measurement falls beyond the upper tolerance area

Before we can use the bit, which will indicate whether the measure still falls within the upper tolerance area (%IWr.m.c.1.6), we need to define the display format and scale of the channel used.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Select the `0..10 V` range for channel 0 (see *(see page 217)*).

Step	Action
4	Access the Parameters dialog box for the channel (see *(see page 220)*) in order to input the following parameters:  The upper tolerance area will be between 100 and 110 liters.
5	Confirm your changes by closing the dialog box.
6	Validate the change with **Edit->Validate**.

The code associated with the fault control transition looks like this:

16.2 Additional Programming Features

Subject of this Section

This section presents some useful additional features for the programming of applications that use analog input/output modules.

What Is in This Section?

This section contains the following topics:

Presentation of Language Objects Associated with the Analog Modules

General

Analog modules are associated with different IODDTs.

The IODDTs are predefined by the manufacturer. They contain input/output language objects belonging to a channel of an analog module.

There are several distinct IODDT types for the analog module:

- `T_ANA_IN_BMX` specific to analog input modules such as the BMX AMI 0410 module and specific to the inputs of the BMX AMM 600 mixed module
- `T_ANA_IN_T_BMX` specific to analog input modules such as the BMX ART 0414/0814
- `T_ANA_OUT_BMX` specific to analog output modules such a s the BMX AMO 0210 module and specific the outputs of the BMX AMM 600 mixed module
- `T_ANA_IN_GEN` specific to all analog input modules such as the BMX AMI 0410, BMX ART 0414/0814, and the inputs of the BMX AMM 600 mixed module

NOTE: IODDT variables may be created in two ways:

- by using the I/O Objects tab,
- by using the data editor.

Types of Language Objects

In each IODDT we find a set of language objects that enable us to control the modules and check their correct operation.

There are two types of language objects:

- **Implicit Exchange Objects**, which are automatically exchanged at each cycle of the task assigned to the module. They concern the inputs/outputs of the module (measurement results, information, commands, etc.).
- **Explicit Exchange Objects**, which are exchanged at the application's request, using explicit exchange instructions. They are used to set the module and perform diagnostics.

Implicit Exchange Language Objects Associated with Analog Modules

At a Glance

An integrated interface or the addition of a module automatically enhances the language objects application used to program this interface or module.

These objects correspond to the input/output images and software data of the module or integrated interface.

Reminders

The module inputs (`%I` and `%IW`) are updated in the PLC memory at the start of the task, the PLC being in RUN or STOP mode.

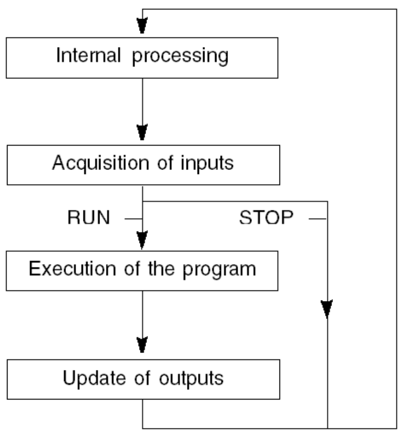
The outputs (`%Q` and `%QW`) are updated at the end of the task, only when the PLC is in RUN mode.

NOTE: When the task occurs in STOP mode, either of the following are possible, depending on the configuration selected:

- Outputs are set to fallback position (fallback mode).
- Outputs are maintained at their last value (maintain mode).

Illustration

The operating cycle of a PLC task (cyclical execution) looks like this:



Explicit Exchange Language Objects Associated with Analog Modules

Introduction

Explicit exchanges are performed at the user program's request, using the following instructions:

- READ_STS: read status words
- WRITE_CMD: write command words
- WRITE_PARAM: write adjustment parameters
- READ_PARAM: read adjustment parameters
- SAVE_PARAM: save adjustment parameters
- RESTORE_PARAM: restore adjustment parameters

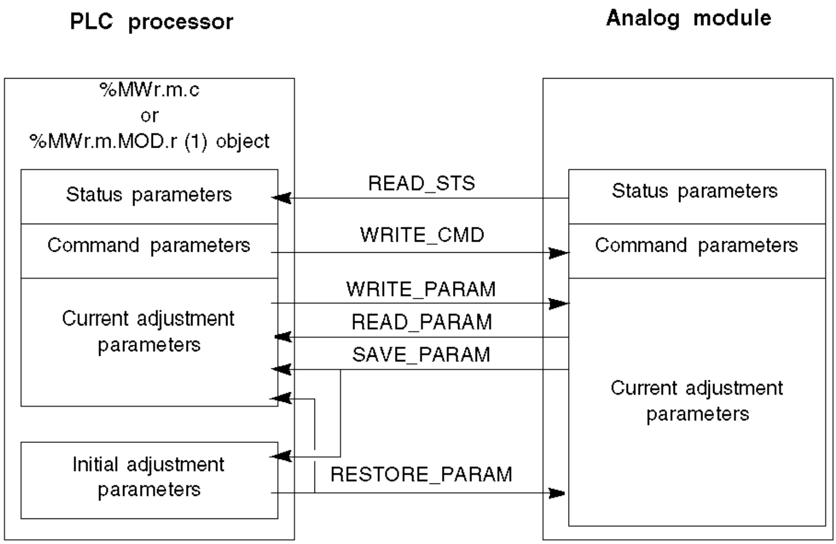
These exchanges apply to a set of %MW objects of the same type (status, commands, or parameters) that belong to a channel.

NOTE: These objects provide information about the module (e.g.: error type for a channel, etc.) and can be used to command them (e.g.: switch command) and to define their operating modes (save and restore currently applied adjustment parameters).

NOTE: You can not send the WRITE_PARAM and RESTORE_PARAM requests at the same time to the channels managed by the same logical nodes, The logical node can only process one request, the other request will generate an error.To avoid this kind of errors you have to manage the exchange for each channel with %MWr.m.c.0.x and %MWr.m.c.1.x.

General Principle for Using Explicit Instructions

The diagram below shows the different types of explicit exchanges that can be made between the processor and module.



(1) Only with READ_STS and WRITE_CMD instructions.

Example of Using Instructions

READ_STS instruction:

The `READ_STS` instruction is used to read `SENSOR_FLT` (`%MWr.m.c.2`) and `NOT_READY` (`%MWr.m.c.3`) words. It is therefore possible to determine with greater precision the errors which may have occurred during operation.

Performing a `READ_STS` of all the channels would result in overloading of the PLC. A less burdensome method would be to test the error bit of all the modules in each cycle, and then the channels of the modules in question. You would then only need to use the `READ_STS` instruction on the address obtained.

The algorithm could look like this:

```
WHILE (%I0.m.ERR <> 1) OR (m <= Number of modules) THEN
  m=m+1
  Loop
END WHILE

WHILE (%I0.m.c.ERR <> 1) OR (c <= Number of channels) THEN
  c=c+1
  Loop
END WHILE

READ_STS (%I0.m.c)
```

WRITE_PARAM instruction:

The `WRITE_PARAM` instruction is used to modify certain configuration parameters for the modules during operation.

All you need to do is to assign the new values to the relevant objects and use the `WRITE_PARAM` instruction on the required channel.

For example, you can use this instruction to modify the fallback value by program (only for output analog modules). Assign the required value to the `Fallback` (`%MWr.m.c.7`) word and then use the `WRITE_PARAM` instruction.

Management of Exchanges and Reports with Explicit Objects

At a Glance

When data is exchanged between the PLC memory and the module, the module may require several task cycles to acknowledge this information. All IODDTs use two words to manage exchanges:

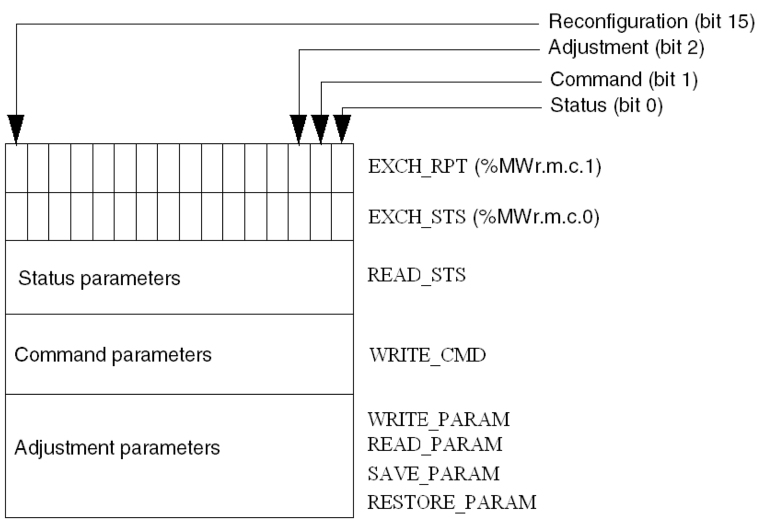
- `EXCH_STS` (`%MWr.m.c.0`) : exchange in progress
- `EXCH_RPT` (`%MWr.m.c.1`) : report

NOTE: Depending on the localization of the module, the management of the explicit exchanges `(%MW0.0.MOD.0.0 for example) will not be detected by the application:`

- for in-rack modules, explicit exchanges are doneimmediately on the local PLC Bus and are finished before the end of the executon task, so the `READ_STS, for example, is always finished when the %MW0.0.mod.0.0 bit is checked by the application.`
- for remote bus (Fipio for example), explicit exchanges are not synchronous with the execution task, so the detection is possible by the application.

Illustration

The illustration below shows the different significant bits for managing exchanges.



Description of Significant Bits

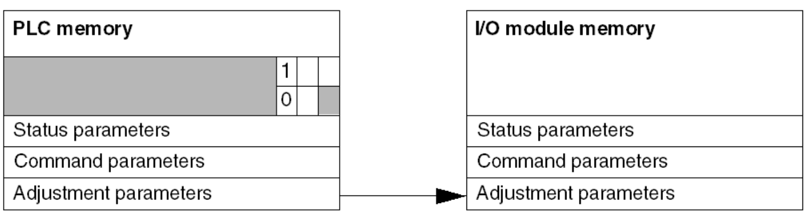
Each bit of the EXCH_STS (%MWr.m.c.0) and EXCH_RPT (%MWr.m.c.1) words is associated with a type of parameter:

- Rank 0 bits are associated with the status parameters:
  - The STS_IN_PROGR bit (%MWr.m.c.0.0) indicates whether a read request for the status words is in progress.
  - The STS_ERR bit (%MWr.m.c.1.0) specifies whether a read request for the status words is accepted by the module channel.
- Rank 1 bits are associated with the command parameters:
  - The CMD_IN_PROGR bit (%MWr.m.c.0.1) indicates whether command parameters are being sent to the module channel.
  - The CMD_ERR bit (%MWr.m.c.1.1) specifies whether the command parameters are accepted by the module channel.
- Rank 2 bits are associated with the adjustment parameters:
  - The ADJ_IN_PROGR bit (%MWr.m.c.0.2) indicates whether the adjustment parameters are being exchanged with the module channel (via WRITE_PARAM, READ_PARAM, SAVE_PARAM, RESTORE_PARAM).
  - The ADJ_ERR bit (%MWr.m.c.1.2) specifies whether the adjustment parameters are accepted by the module. If the exchange is correctly executed, the bit is set to 0.
- Rank 15 bits indicate a reconfiguration on channel c of the module from the console (modification of the configuration parameters and cold start-up of the channel).
- Bits r, m, and c indicate the following slots:
  - Bit r represents the rack number.
  - Bit m represents the position of the module in the rack.
  - Bit c represents the channel number in the module.

NOTE: Exchange and report words also exist at the level of EXCH_STS (%MWr.m.MOD.0) and EXCH_RPT (%MWr.m.MOD.1) modules, as per T_ANA_IN_BMX, T_ANA_IN_T_BMX and T_ANA_OUT_BMX-type IODDTs.

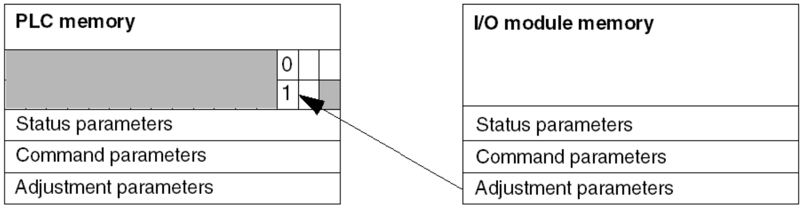
Example

Phase 1: Sending data by using the WRITE_PARAM instruction:



When the instruction is scanned by the PLC processor, the `Exchange in progress` bit is set to 1 in `%MWr.m.c`.

Phase 2: Analysis of the data by the input/output module and report:



When data is exchanged between the PLC memory and the module, acknowledgement by the module is managed by the `ADJ_ERR` (`%MWr.m.c.1.2`) bit which, depending on its value, gives the following report:

- **0:** correct exchange.
- **1:** error in exchange.

NOTE: There is no adjustment parameter at module level.

Explicit Exchange Execution Flag: EXCH_STS

The table below shows the `EXCH_STS` (`%MWr.m.c.0`) explicit exchange control bits.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Reading of channel status words in progress	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameters exchange in progress	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjust parameters exchange in progress	%MWr.m.c.0.2
RECONF_IN_PROGR	BOOL	R	Reconfiguration of the module in progress	%MWr.m.c.0.15

NOTE: If the module is not present or is disconnected, explicit exchange objects (`READ_STS`, for example) are not sent to the module (`STS_IN_PROG (%MWr.m.c.0.0) = 0`), but the words are refreshed.

Explicit Exchange Report: EXCH_RPT

The table below presents the `EXCH_RPT` (`%MWr.m.c.1`) report bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error reading channel status words (1 = error)	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during a command parameter exchange (1 = error)	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters (1 = error)	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error during reconfiguration of the channel (1 = error)	%MWr.m.c.1.15

Language Objects Associated with Configuration

At a Glance

The configuration of an analog module is stored in the configuration constants (%KW).

The parameters r,m, and c shown in the following tables represent the topologic addressing of the module. Each parameter had the following signification:

- **r:** represents the rack number
- **m:** represents the position of the module on the rack
- **c:** represents the channel number

BMX AMI 0410, BMX AMI 0800 and BMX AMI 0810 Configuration Objects and Inputs of BMX AMM 0600

The following table lists all process control language objects associated to the configuration of the BMX AMI 0410, BMX AMI 0800 and BMX AMI 0810 modules:

Addresses	Description	Bits meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** electric range (hexadecimal value) **Bit 7:** 0=electrical range (always 0)
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-
%KWr.m.c.3	Over range below value	-
%KWr.m.c.4	Over range above value	-
%KWr.m.c.5	Channel treatment configuration	**Bit 0:** 0=Standard mode, 1=Fast mode **Bit 1:** 0=channel disabled, 1=channel enabled **Bit 2:** 0=sensor monitor off, 1=sensor monitor on **Bit 7:** 0=Manufacturer scale, 1=user scale **Bit 8:** over range lower threshold enabled **Bit 9:** over range upper threshold enabled

BMX ART 0414/0814 Configuration Objects

The following table lists all process control language objects associated to the configuration of the BMX ART 0414/0814 modules:

Addresses	Description	Bits meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** Temperature range (hexadecimal value) **Bit 6:** Temperature range (0=° C, 1=F°) **Bit 7:** 1=Temperature range **Bit 8:** 0=rejection 50 Hz, 1=rejection 60 Hz
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-
%KWr.m.c.3	Over range below value	-
%KWr.m.c.4	Over range above value	-
%KWr.m.c.5	Channel treatment configuration	**Bit 0:** 0=Standard mode (always 0) **Bit 1:** 0=channel disabled (only in Fast mode), 1=channel enabled **Bit 2:** 0=sensor monitor off, 1=sensor monitor on **Bits 3 to 6:** CJC Configuration Mode for channels 0/3: • Bit 3=0 and Bit 4=0: Int. Telefast, • Bit 3=1 and Bit 4=0: External RTD, • Bit 3=0 and Bit 4=1: CJC on channels 4/7. **Bits 3 to 6:** CJC Configuration Mode for channels 4/7: • Bit 5=0 and Bit 6=0: Int. Telefast, • Bit 5=1 and Bit 6=0: External RTD. **Bit 7:** 0=Manufacturer scale, 1=user scale **Bit 8:** Over range lower threshold enabled **Bit 9:** Over range upper threshold enabled

BMX AMO 0210, BMX AMO 0410 and BMX AMO 0802 Configuration Objects and Outputs of BMX AMM 0600

The following table lists all process control language objects associated to the configuration of the BMX AMO 0210, BMX AMO 0410 and BMX AMO 0802 modules:

Addresses	Description	Bits meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** binary value) **Bit 8:** Fallback mode (0=Fallback, 1=Maintain) **Bit 11:** Actuator wiring control (0=disabled, 1=enabled) **Bit 14:** Output lower OOR valid (0=disabled, 1=enabled) **Bit 15:** Output upper OOR valid (0=disabled, 1=enabled)
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-
%KWr.m.c.3	Overshoot below value	-
%KWr.m.c.4	Overshoot above value	-

Quick Start: Example of Analog I/O Module Implementation

III

In this Part

This part presents an example of implementation of the analog input/output modules.

What Is in This Part?

This part contains the following chapters:

Description of the Application

17

Overview of the Application

At a Glance

The application described in this document is used to manage the level of a liquid in a tank. The tank is filled by a pump, and drained using a valve.

The level of the tank is measured with an ultrasonic sensor placed below of the tank.

The volume of the tank is shown by a digital display.

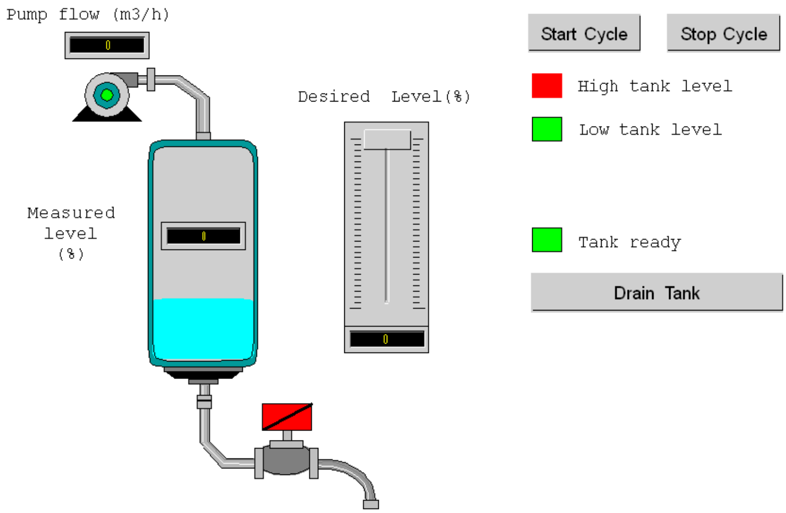
The desired level of liquid is defined by the operator, using a potentiometer

The application’s operation control resources are based on an operator screen, which shows the status of the various sensors and actuators, as well as the level of the tank.

The high tank level is defined through the operator screen.

Illustration

This is the application's final operator screen:



Operating Mode

The operating mode is as follows:

- A potentiometer is used to defined the desired level.
- A **Start Cycle** button is used to start the filling.
- When the desired level of the tank is reached, the pump stops and the **Tank ready** led lights up.
- A **Drain tank** button is used to start the tank draining.
- When the low level of the tank is reached, the valve closes. The **Start Cycle** button is used to restart the filling.
- A **Stop Cycle** button is used to interrupt the filling. Pressing this button allows you to set the system to a safe level. The pump stops and the valve opens until the low level is reached (tank empty). The valve closes.
- The pump has a variable flow rate, the value of which can be accessed by the operator screen. The more the level of liquid is raised, the more the flow is reduced.
  The flow rate of the valve is fixed.
- A safety measure must be installed. If the high level is exceeded, a safety measure is activated and the system is set to failsafe. The pump then stops and the valve opens until the low level is reached (tank empty). The valve closes.
- For failsafe mode, an error message must be displayed.
- The time that the valve is open and closed is monitored, with an error message being displayed if either of these is exceeded.

Installing the Application Using Unity Pro

18

Subject of this Chapter

This chapter describes the procedure for creating the application described. It shows, in general and in more detail, the steps in creating the different components of the application.

What Is in This Chapter?

This chapter contains the following sections:

18.1 Presentation of the Solution Used

Subject of this Section

This section presents the solution used to develop the application. It explains the technological choices and gives the application’s creation timeline.

What Is in This Section?

This section contains the following topics:

Technological Choices Used

At a Glance

There are several ways of writing an application using Unity Pro. The one proposed allows you to structure the application so as to facilitate its creation and debugging.

Technological Choices

The following table shows the technological choices used for the application.

Objects	**Choices used**
Use of the pump	Creation of a user function block (DFB) to facilitate management of the pump in terms of entering a program and speed of debugging. The programming language used to develop this DFB is a function block diagram (FBD)-based graphic language.
Use of the valve	Creation of a user function block (DFB) to facilitate management of the valve in terms of entering a program and speed of debugging. The programming language used to develop this DFB is a function block diagram (FBD)-based graphic language.
Supervision screen	Use of elements from the library and new objects.
Main supervision program	This program is developed using a sequential function chart (SFC), also called GRAFCET. The various sections are created in Ladder Diagram (LD) language, and use the different DFBs created.
Fault display	Use of the ALRM_DIA DFB to control the status of the variables linked with the detected errors.

NOTE: Using a DFB function block in an application enables you to:

- simplify the design and entry of the program
- increase the legibility of the program
- facilitate debugging the application
- reduce the volume of generated code

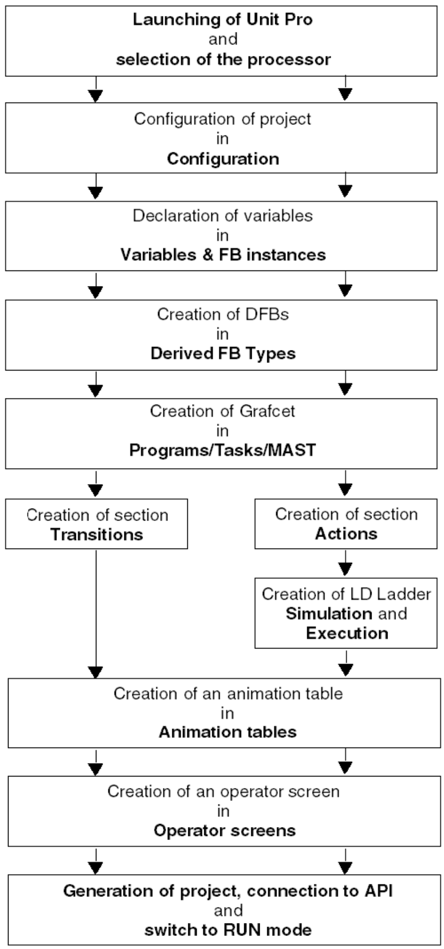
The Different Steps in the Process Using Unity Pro

At a Glance

The following logic diagram shows the different steps to follow to create the application. A chronological order must be respected in order to correctly define all of the application elements.

Description

Description of the different types:



18.2 Developing the Application

Subject of this Section

This section gives a step-by-step description of how to create the application using Unity Pro.

What Is in This Section?

This section contains the following topics:

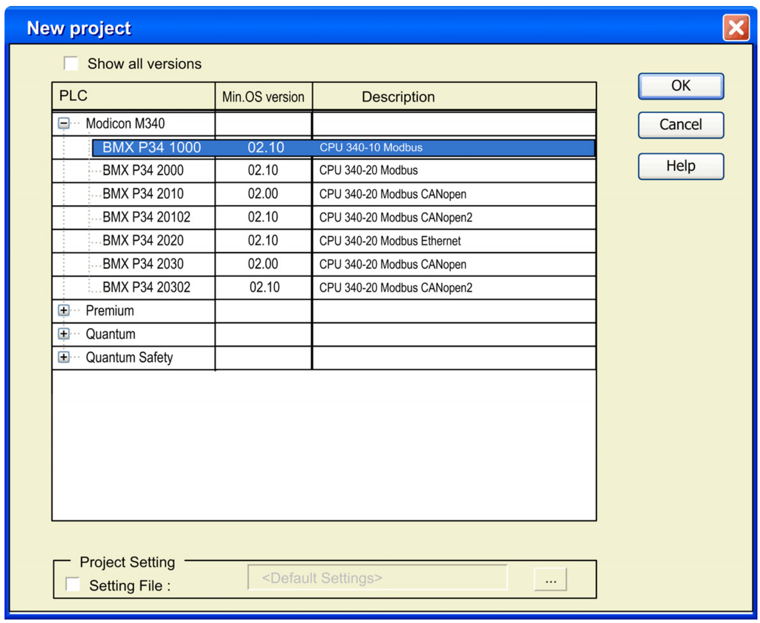
Creating the Project

At a Glance

Developing an application using Unity Pro involves creating a project associated with a PLC.

Procedure for Creating a Project

The table below shows the procedure for creating the project using Unity Pro.

<table>
<tr><th>Etape</th><th>Action</th></tr>
<tr><td>1</td><td>Launch the Unity Pro software.</td></tr>
<tr><td>2</td><td>Click File then New to select a PLC.

</td></tr>
<tr><td>3</td><td>To see all PLC versions, click on the box Show all versions.</td></tr>
<tr><td>4</td><td>Select the processor you wish to use from those proposed.</td></tr>
<tr><td>5</td><td>To create a project with specific values of project settings, check the box Settings File and use the browser button to localize the .XSO file (Project Settings file). It is also possible to create a new one.
If the Settings File box is not checked , default values of project settings are used.</td></tr>
<tr><td>6</td><td>Confirm with OK.</td></tr>
</table>

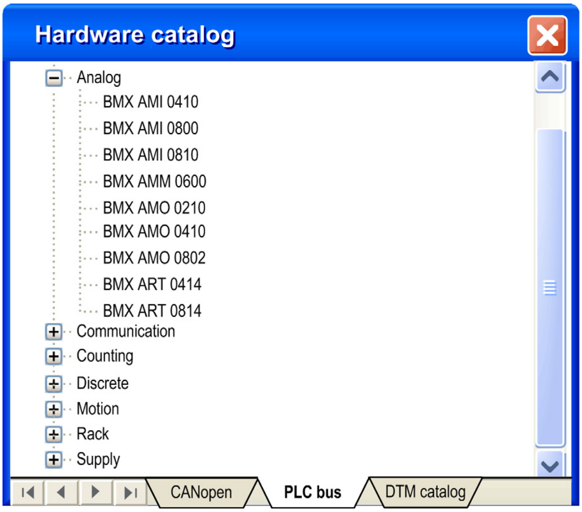
Selection of the Analog Module

At a Glance

Developing an analog application involves choosing the right module and appropriate configuration.

Module Selection

The table below shows the procedure for selecting the analog module.

Step	Action
1	In the `Project browser` double-click `Configuration`, `0:PLC bus`, `0:BMX ••• •••` (Where 0 is the rack number) and double-click a slot.
2	In the `Hardware Catalog` window, select the `BMX AMI 0410` input module then drag and drop it in the `PLC bus` window. 
3	Do the same for the BMX AMO 0210 output module.

Declaration of Variables

At a Glance

All of the variables used in the different sections of the program must be declared.

Undeclared variables cannot be used in the program.

NOTE: For more information, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Operate modes`, and `Data editor`).

Procedure for Declaring Variables

The table below shows the procedure for declaring application variables.

Step	Action
1	In Project browser / Variables & FB instances, double-click on Elementary variables
2	In the Data editor window, select the box in the Name column and enter a name for your first variable.
3	Now select a Type for this variable.
4	When all your variables are declared, you can close the window.

Variables Used for the Application

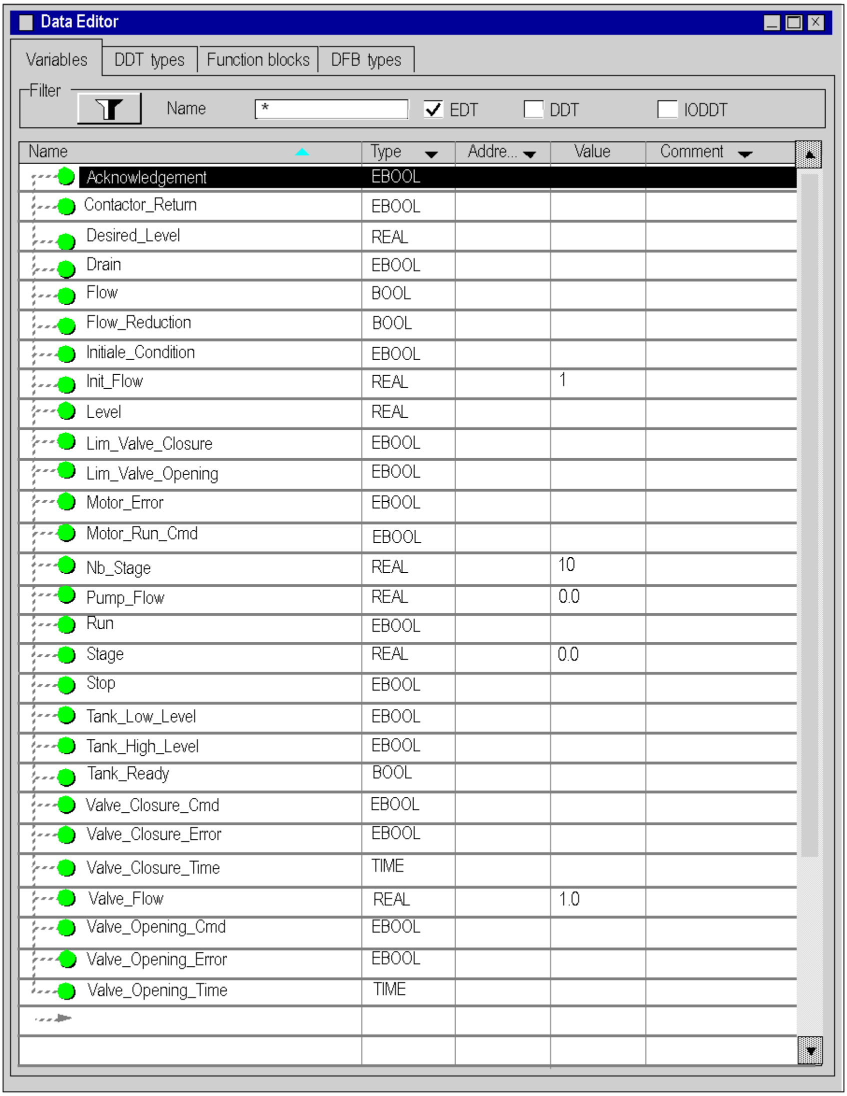
The following table shows the details of the variables used in the application.

Variable	Type	Definition
Acknowledgement	EBOOL	Acknowledgement of an error (Status 1).
Stop	EBOOL	Stop cycle at end of draining (Status 1).
Valve_Opening_Cmd	EBOOL	Opening of the valve (Status 1).
Motor_Run_Cmd	EBOOL	Startup request for filling cycles (Status 1).
Valve_Closing_Cmd	EBOOL	Closing of the valve (Status 1).
Initiale_condition	EBOOL	Transition that starts the pump.
Desired_Level	REAL	Desired level of liquid.
Tank_ready	BOOL	Tank is full, ready to be drained.
Flow	BOOL	Intermediate variable for simulating the application.
Init_Flow	REAL	Pump initial flow rate.
Flow_Reduction	BOOL	Pump flow rate after reduction.
Pump_Flow	REAL	Pump flow rate.
Valve_Flow	REAL	Valve flow rate.
Motor_Error	EBOOL	Error returned by the motor.

Variable	Type	Definition
Valve_Closure_Error	EBOOL	Error returned by the valve on closing.
Valve_Opening_Error	EBOOL	Error returned by the valve on opening.
Lim_Valve_Closure	EBOOL	Valve in closed position (Status 1).
Lim_Valve_Opening	EBOOL	Valve in opened position (Status 1)
Run	EBOOL	Startup request for filling cycles (Status 1).
Nb_Stage	REAL	Number of tank filling stage.
Level	REAL	Level of liquid in the tank.
Tank_low_level	EBOOL	Tank volume at low level (Status 1).
Tank_high_level	EBOOL	Tank volume at high level (Status 1).
Stage	REAL	Stage incrementation value.
Contactor_Return	EBOOL	Error returned by the contactor in the event of motor error.
Valve_closure_time	TIME	Valve closure time.
Valve_opening_time	TIME	Valve opening time.
Drain	EBOOL	Drain command

NOTE: EBOOL types can be used for I/O modules, unlike BOOL types.

The following screen shows the application variables created using the data editor:



Creation and Use of the DFBs

At a Glance

DFB types are function blocks that can be programmed by the user ST, IL, LD or FBD. Our example uses a motor DFB and a valve DFB.

We will also be using existing DFB from the library for monitoring variables. Particularly "safety" variables for tank levels, and "error" variables returned by the valve. The status of these variables will be visible in Diagnostics display.

NOTE: Function blocks can be used to structure and optimize your application. They can be used whenever a program sequence is repeated several times in your application, or to set a standard programming operation (for example, an algorithm that controls a motor).

Once the DFB type is created, you can define an instance of this DFB via the variable editor or when the function is called in the program editor.

NOTE: For more information, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Language references`, and `User function block`

Procedure for Creating a DFB

The table below shows the procedure for creating application DFBs.

Step	Action
1	In the `Project browser`, right click on `Derived FB types` and select `Open`.
2	In the `Data editor` window, select the box in the `Name` column and enter a name for your DFB and confirm with `Enter`. The name of your DFB appears with the sign "Works" (unanalyzed DFB).
3	Open the structure of your DFB (see figure next page) and add the inputs, outputs and other variables specific to your DFB.
4	When the variables of the DFB are declared, analyze your DFB (the sign "Works" must disappear). To analyze your DFB, select the DFB and, in the menu, click `Build` then `Analyze`. You have created the variables for your DFB, and must now create the associated section.
5	In the `Project browser`, double-click on `Derived FB types` then on your DFB. Under the name of your DFB, the `Sections` field will appear.
6	Right click on `Sections` then select `New section`.
7	Give your section a name, then select the language type and confirm with `OK`. Edit your section using the variables declared in step 3. Your DFB can now be used by the program (DFB Instance).

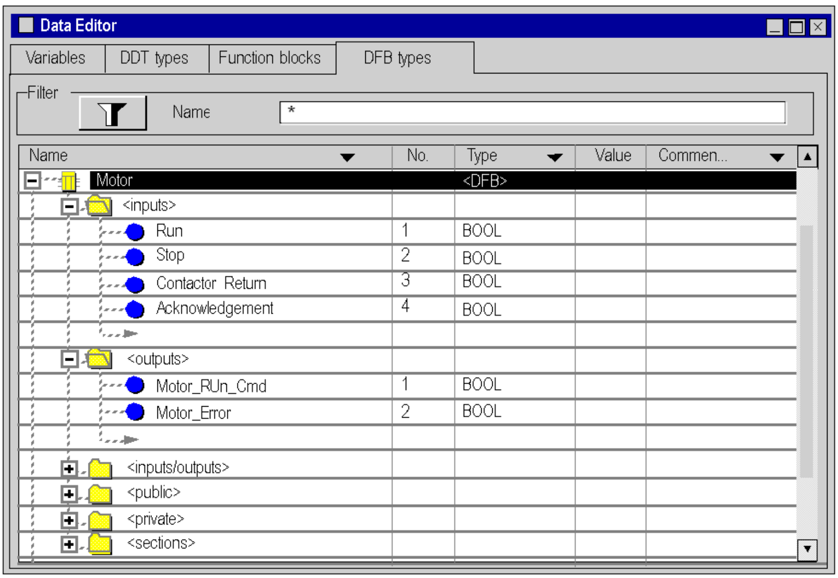
Variables Used by the Motor DFB

The following table lists the variables used by the Motor DFB.

Variable	Type	Definition
Run	Input	Motor run command.
Stop	Input	Motor stop command.
Contactor_Return	Input	Contactor feedback in the event of motor run problem.
Acknowledgement	Input	Acknowledgement of the Motor_error output variable.
Motor_Run_Cmd	Output	Start of motor.
Motor_Error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the motor.

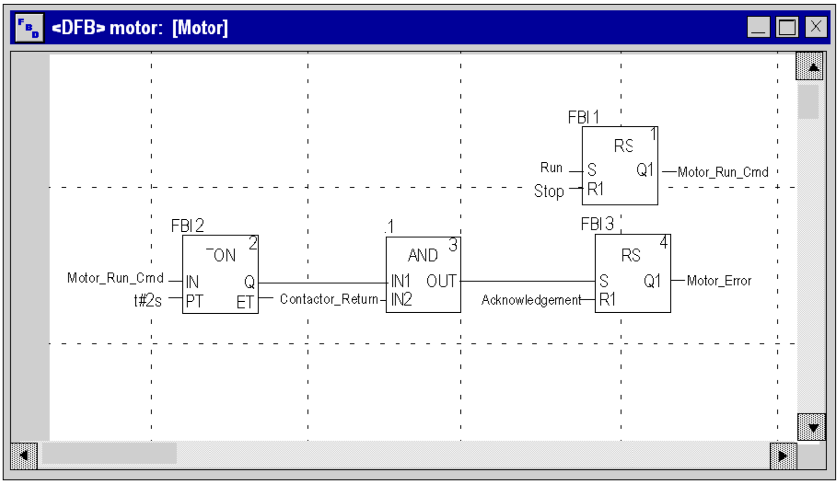
Illustration of the Motor DFB Variables Declared in the Data Editor

The following screen shows the Motor DFB variables used in this application to control the motor.



Operating Principle of the Motor DFB

The following screen shows the Motor DFB program written by the application in FBD for controlling the motor.



When Run = 1 and Stop = 0, the motor can be controlled (Motor_Run_Cmd = 1). The other part monitors the Contactor_return variable. If Contactor_return is not set to "1" after the Discrete counter counts two seconds, the Motor_error output switches to "1".

NOTE: Note: For more information on creating a section, consult the Unity Pro online help (click ?, then `Unity`, then `Unity Pro`, then `Operate Modes` and `Programming` and select the required language).

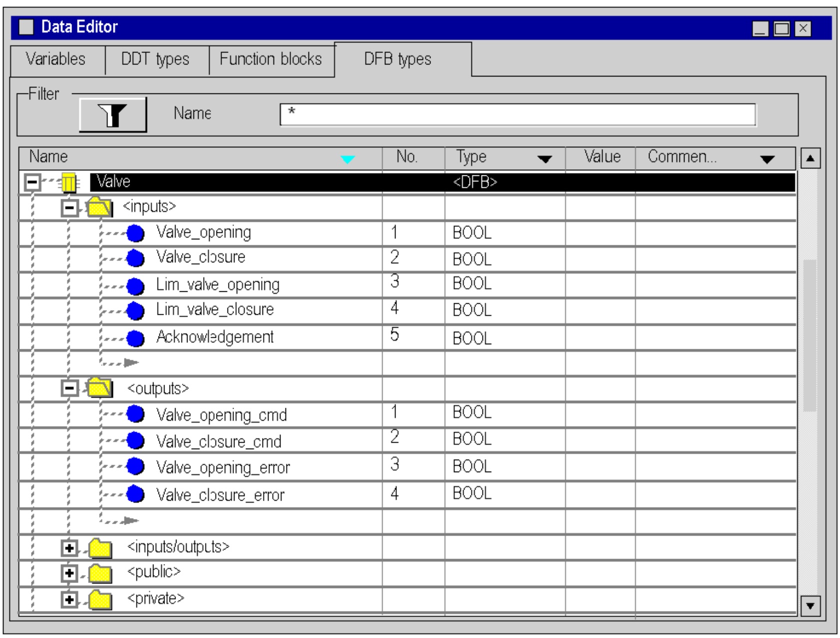
Variables Used by the Valve DFB

The following table lists the variables used by the Valve DFB.

Variable	Type	Definition
Valve_opening	Input	Valve opening command.
Valve_closure	Input	Valve closure command.
Lim_valve_opening	Input	Status of valve limit.
Lim_valve_closure	Input	Status of valve limit.
Acknowledgement	Input	Acknowledgement of variables Valve_closure_error or Valve_opening_error.
Valve_opening_cmd	Output	Opening of the valve.
Valve_closure_cmd	Output	Closure of the valve.
Valve_opening_error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the valve opening.
Valve_closure_error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the valve closure.

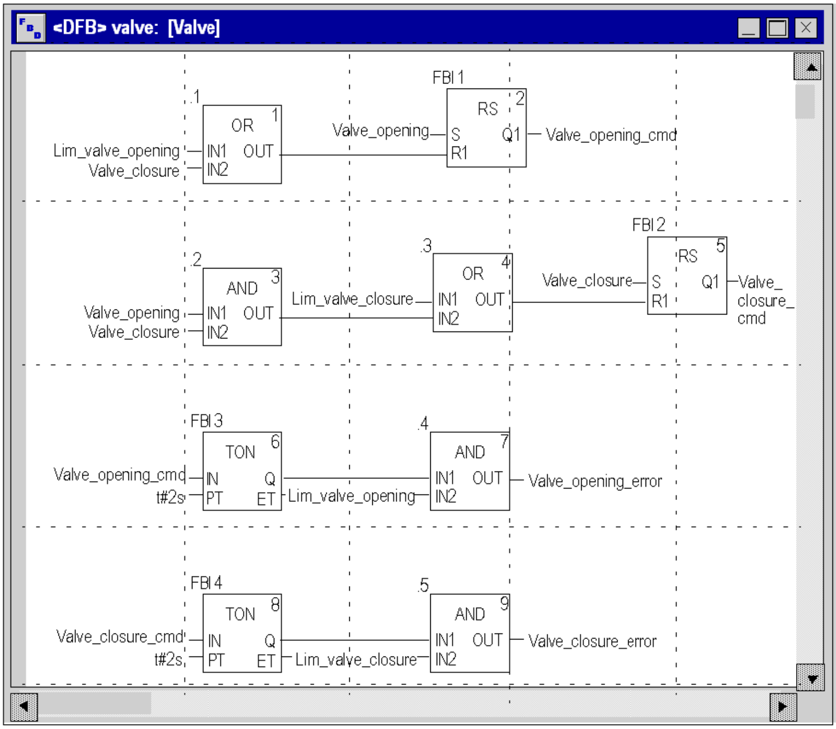
Illustration of the Valve DFB Variables Declared in the Data Editor

The following screen shows the Valve DFB variables used in this application to control the valve.



Operating Principle of the Valve DFB

The following screen shows the Valve DFB written in FBD language.



This DFB authorizes the command to open the valve (Valve_opening_cmd) when the inputs Valve_closure and Lim_valve_opening are set to "0". The principle is the same for closure, with an additional safety feature if the user requests the opening and closing of the valve at the same time (opening takes priority).

In order to monitor opening and closing times, we use the TON timer to delay the triggering of an error condition. Once the valve opening is enabled (Valve_opening_cmd = 1), the timer is triggered. If Lim_valve_opening does not switch to "1" within two seconds, the output variable Valve_opening_error switches to "1". In this case a message is displayed.

NOTE: The PT time must be adjusted according to your equipment.

NOTE: For more information on creating a section, consult the Unity Pro online help (click ?, then `Unity`, then `Unity Pro`, then `Operate Modes` and `Programming` and select the required language).

Creating the Program in SFC for Managing the Tank

At a Glance

The main program is written in SFC (Grafcet). The different sections of the grafcet steps and transitions are written in LD. This program is declared in a MAST task, and will depend on the status of a Boolean variable.

The main advantage of SFC language is that its graphic animation allows us to monitor in real time the execution of an application.

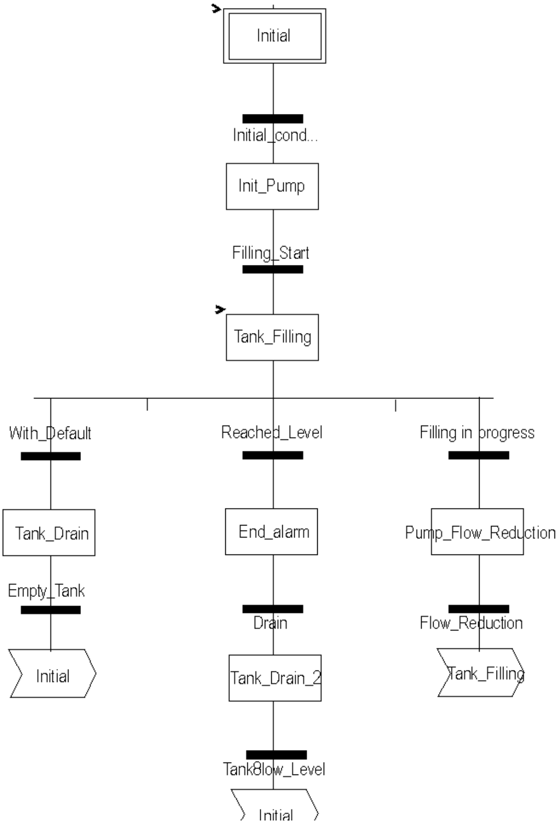
Several sections are declared in the MAST task:

- The **Tank_management** (See *Illustration of the Tank_management Section, page 303*) section, written in SFC and describing the operate mode,
- The **Execution** (See *Creating a Program in LD for Application Execution, page 306*) section, written in LD, which executes the pump start-up using the motor DFB, as well as the opening and closure of the valve.
- The **Simulation** (See *Creating a Program in LD for Application Simulation, page 308*) section, written in LD, which simulates the application. This section must be deleted in the case of connection to a PLC.

NOTE: The LD, SFC and FBD-type sections used in the application must be animated in online mode (See *Starting the Application, page 315*), with the PLC in RUN

Illustration of the Tank_management Section

The following screen shows the application Grafcet:



For actions and transitions used in the grafcet, see *Actions and transitions, page 323*

NOTE: For more information on creating an SFC section, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Operate modes`, then `Programming` and `SFC editor`.

Description of the Tank_management Section

The following table describes the different steps and transitions of the Tank_management Grafcet:

Step / Transition	Description
Initial	This is the initial step.
Initial_condition	This is the transition that starts the pump. The transition is valid when the variables: • Stop = 0, • Run = 1, • Tank_High_Level = 0, • Lim_valve_closure = 1 • Desired_Level > 0
Init_Pump	This is the step initiate the pump flow rate.
Filling_Start	This transition is active when the pump flow rate is initialized.
Tank_Filling	This is the step that starts the pump and filling of the tank until the high level is reached. This step activates the motor DFB in the Application section, which controls the activation of the pump.
Reached_Level	This transition is active when the tank's desired level is reached.
End_Alarm	This is the step that lights the **Tank ready** led
Drain	This transition is active when the operator click on the **Drain Tank** button (Drain = 1).
Tank_Drain_2	This step is identical to Tank_Drain.
Tank_Low_Level	This transition is active when the low level of the tank is reached (Tank_Low_Level = 1).
With_fault	This transition is active when High_Safety_Alarm = 1 or the Stop_cycle button has been activated (Stop_cycle = 1).
Tank_Drain	This step activates the valve DFB in the Application section, which controls the opening of the valve.
Empty_Tank	This transition is valid when the tank is empty (Tank_Low_Level = 1 and Pump_Flow = 0.0).
Filling in progress	This transition is valid when the filling of the tank is in progress.
Pump_Flow_Reduction	This is the step that reductes the pump flow rate.
Flow_Reduction	This is the value of the flow rate after reduction.

NOTE: You can see all the steps and actions and transitions of your SFC by clicking on in front of the name of your SFC section.

Procedure for Creating an SFC Section

The table below shows the procedure for creating an SFC section for the application.

Step	Action
1	In `Project Browser\Program\Tasks`, double-click on `MAST`.
2	Right click on `Section` then select `New section`. Give your section a name (Tank_management for the SFC section) then select SFC language.
3	The name of your section appears, and can now be edited by double clicking on it.
4	The SFC edit tools appear in the window, which you can use to create your Grafcet. For example, to create a step with a transition: ● To create the step, click on  then place it in the editor, ● To create the transition, click on  then place it in the editor (generally under the preceding step).

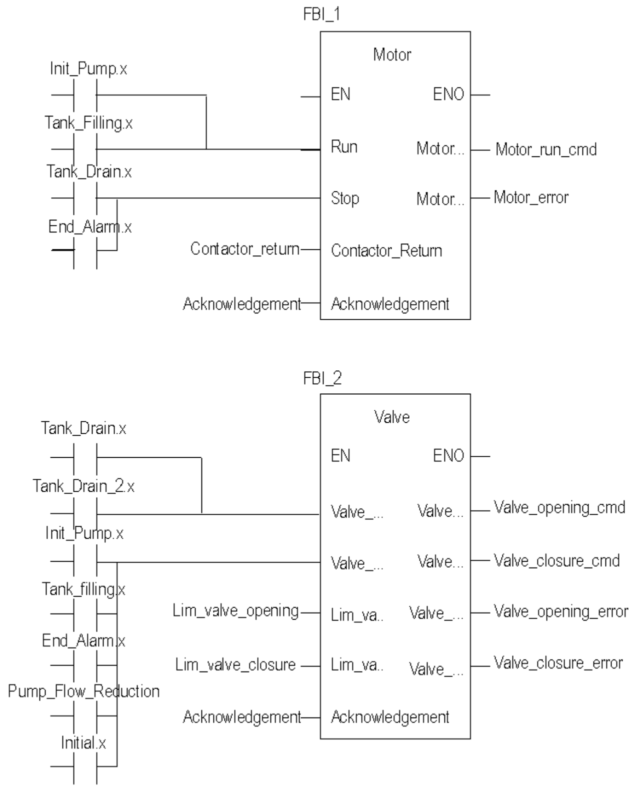
Creating a Program in LD for Application Execution

At a Glance

This section controls the pump and the valve using the DFBs created (See *Creation and Use of the DFBs, page 297*) earlier.

Illustration of the Execution Section

The section below is part of the MAST task. It has no temporary condition defined for it so it is permanently executed.



Description of the Application Section

When the Pump step is active, the Run input of the motor DFB is at 1. The `Motor_run_cmd` switches to "1" and the pump supply is activated.

The same principle applies to the rest of the section.

Procedure for Creating an LD Section

The table below describes the procedure for creating part of the **Application** section.

Step	Action
1	In `Project Browser\Program\Tasks`, double-click on `MAST`.
2	Right click on `Section` then select `New section`. Name this section Application, then select the language type LD. The edit window opens.
3	To create the contact Init_Pump.x, click on ⊣⊢ then place it in the editor. Double-click on this contact then enter the name of the step with the suffix ".x" at the end (signifying a step of an SFC section) and confirm with `OK`.
4	To use the motor DFB you must instantiate it. Right click in the editor then click on `Select data` and on ... . Click on the `Function and Function Block Types` tab and select your DFB then confirm with `OK` and position your DFB. To link the Open_valve1.x contact to the stop input of the DFB, align the contact and the input horizontally, click on and position the link between the contact and the input.

NOTE: For more information on creating an LD section, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Operate modes`, then `Programming` and `LD editor`).

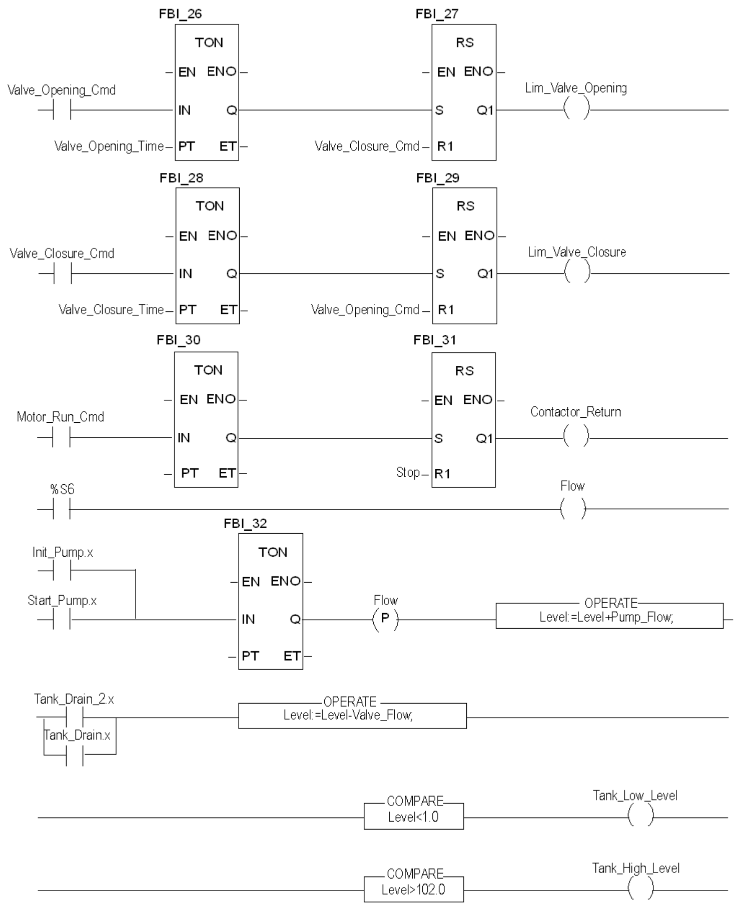
Creating a Program in LD for Application Simulation

At a Glance

This section is only used for application simulation. It should therefore not be used if a PLC is connected.

Illustration of the Simulation Section

The section below is part of the MAST task. It has no condition defined for it so it is permanently executed:



NOTE: For more information on creating an LD section, see Unity Pro online help (click on ?, then `Unity`, then Software`Unity Pro`, then `Operate modes` , then `Programming` and `LD editor`).

Description of the Simulation Section

- The first line of the illustration is used to simulate the value of the Lim_valve_opening variable. If the valve opening command is given (`Valve_opening_cmd` = 1), a TON timer is triggered. When the PT time is reached, the TON output switches to "1" and increments the `Lim_valve_opening` output to "1" unless the valve closure command is given at the same time.
- Same principle applies to the `Lim_valve_closure` and `Contactor_return` outputs.
- The last part of the section is used for the simulation of the tank level and for triggering the different tank levels. The OPERATE and COMPARE blocks from the library can be used to do this.

Creating an Animation Table

At a Glance

An animation table is used to monitor the values of variables, and modify and/or force these values. Only those variables declared in `Variables & FB instances` can be added to the animation table.

NOTE: For more information, consult the Unity Pro online help (click ?, then `Unity`, then `Unity Pro`, then `Operate modes`, then `Debugging and adjustment` then `Viewing and adjusting variables` and `Animation tables`).

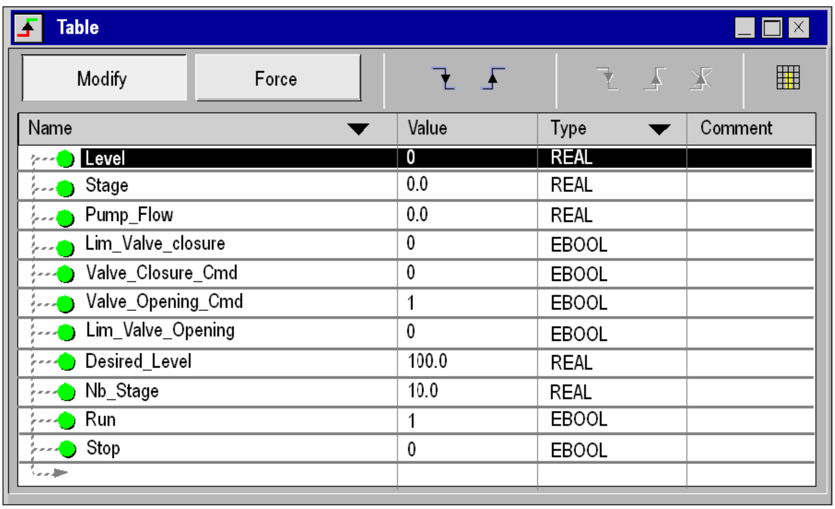
Procedure for Creating an Animation Table

The table below shows the procedure for creating an animation table.

Step	Action
1	In the `Project browser`, right click on `Animation tables`. The edit window opens.
2	Click on first cell in the Name column, then on the button, and add the variables you require.

Animation Table Created for the Application

The following screen shows the animation table used by the application:



NOTE: The animation table is dynamic only in online mode (display of variable values).

Creating the Operator Screen

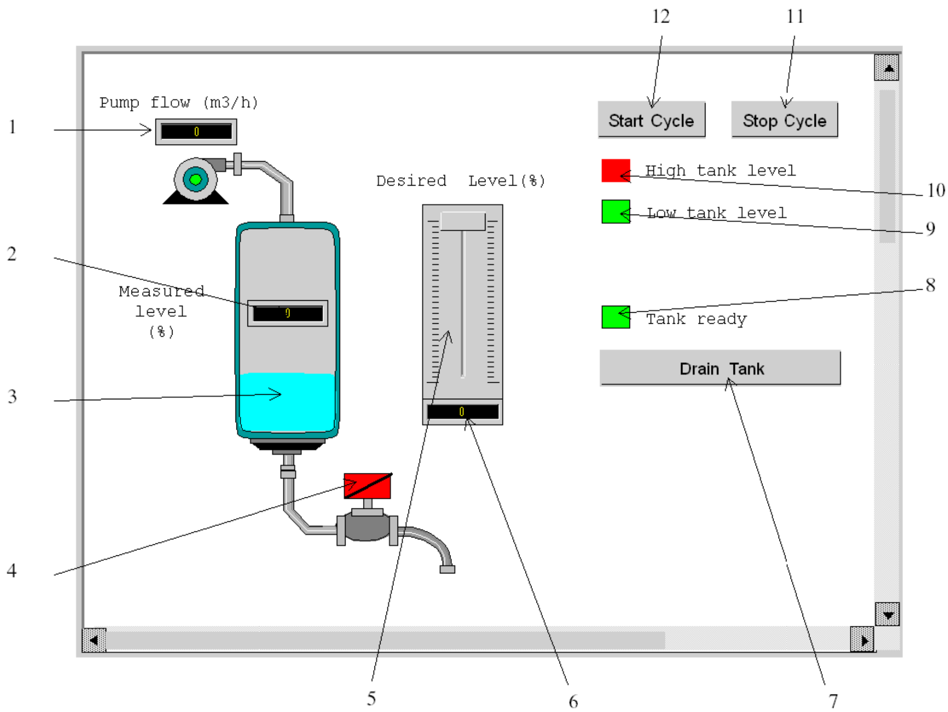
At a Glance

The operator screen is used to animate graphic objects that symbolize the application. These objects can belong to the Unity Pro library, or can be created using the graphic editor.

NOTE: For more information, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Operate modes`, and `Operator screens)`.

Illustration of the Operator Screen

The following illustration shows the application operator screen:



The associated variables are presented in the table below:

N°	Description	Associated variable
1	Pump flow indicator	Pump_Flow
2	Mesured level indicator	Level
3	Representation of the level in the tank	Level

N°	Description	Associated variable
4	Valve	Lim_Valve_Closure
5	Scale indicator	Desired_Level
6	Desired level indicator	Desired_Level
7	Tank Draining button	Drain
8	"Tank ready" indicator light	Tank_Ready
9	"Low tank level" indicator light	Tank_Low_Level
10	"High tank level" indicator light	Tank_High_Level
11	Stop button	Stop
12	Start button	Run

NOTE: To animate objects in online mode, you must click on . By clicking on this button, you can validate what is written.

Procedure for Creating an Operator Screen

The table below shows the procedure for inserting and animating the tank.

Step	Action
1	In the `Project browser`, right click on `Operator screens` and click on `New screen`. The operator screen editor appears.
2	• In the `Tools` menu, select `Operator Screen Library`. The window opens. Double click on `Fluids` then `Tank`. Select the dynamic tank from the runtime screen, and `Copy` (Ctrl + C) then `Paste` (Ctrl + V) it into the drawing in the operator screen editor (to return to your screen, click on `Window` then `Screen`). • The tank is now in your operator screen. You now need a variable to animate the level. In the `Tools` menu, click on `Variables Window`. The window appears to the left, and in the `Name` column we see the word %MW0. To obtain the animated part of the graphic object (in this case the tank), double click on %MW0. A part of the tank is selected. Right click on this part, then click on `Characteristics`. Select the `Animation` tab and enter the variable concerned by clicking the ... button (in the place of %MW0). In our application, this will be Tank_vol. • You must define the tank's minimum and maximum values. In the `Type of animation` tab, click `Bar chart` then the button, and fill in the entry fields according to the tank. • Confirm with `Apply` and `OK`.
3	Click on to select the other lines one by one and apply the same procedure.

The table below shows the procedure for creating the Start button.

Step	Action
1	In the `Project browser`, right click on `Operator screens` and click on `New screen`. The operator screen editor appears.
2	Click on the [button icon] and position the new button on the operator screen. Double click on the button and in the `Control` tab, select the Run variable by clicking the button ... and confirm with OK. Then, enter the button name in the text zone.

NOTE: In the `Instance Selection`, tick the IODDT checkbox and click on [+] to access the I/O objects list.

Starting the Application

19

Subject of this Chapter

This chapter shows the procedure for starting the application. It describes the different types of application executions.

What Is in This Chapter?

This chapter contains the following topics:

Execution of Application in Simulation Mode

At a Glance

You can connect to the API simulator which enables you to test an application without a physical connection to the PLC and other devices.

NOTE: For more information, see Unity Pro online help (click on ?, then `Unity`, then `Unity Pro`, then `Operate modes`, then `Debugging and adjustment` and `PLC simulator`).

Application Execution

The table below shows the procedure for launching the application in simulation mode:

Step	Action
1	In the `PLC` menu, click on `Simulation Mode`,
2	In the `Build` menu, click on `Rebuild All Project`. Your project is generated and is ready to be transferred to the simulator. When you generate the project, you will see a results window. If there is an error in the program, Unity Pro indicates its location if you double-click on the highlighted sequence.
3	In the `PLC` menu, click on `Connection`. You are now connected to the simulator.
4	In the `PLC` menu, click on `Transfer project to PLC`. The `Transfer project to PLC` window opens. Click on `Transfer`. The application is transferred to the PLC simulator.
5	In the `PLC`, click on `Execute`. The `Execute` window opens. Click on `OK`. The application is now being executed (in RUN mode) on the PLC simulator.

Execution of Application in Standard Mode

At a Glance

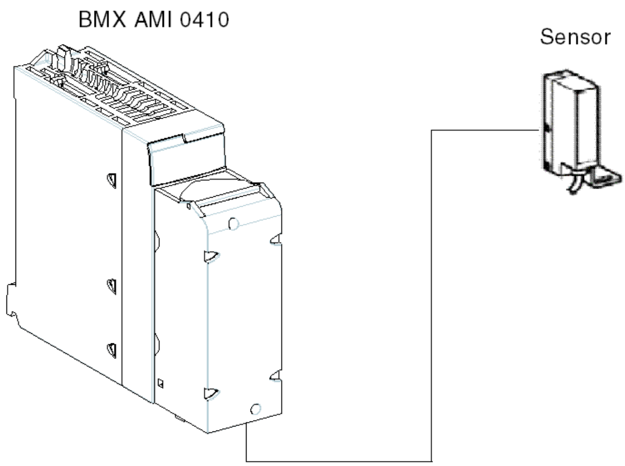
To work in standard mode you need to use a PLC and Analog I/O modules to assign outputs to different sensors and actuators.

The variables used in simulation mode must be modified. In standard mode, variables must be located to be associated to physical I/Os.

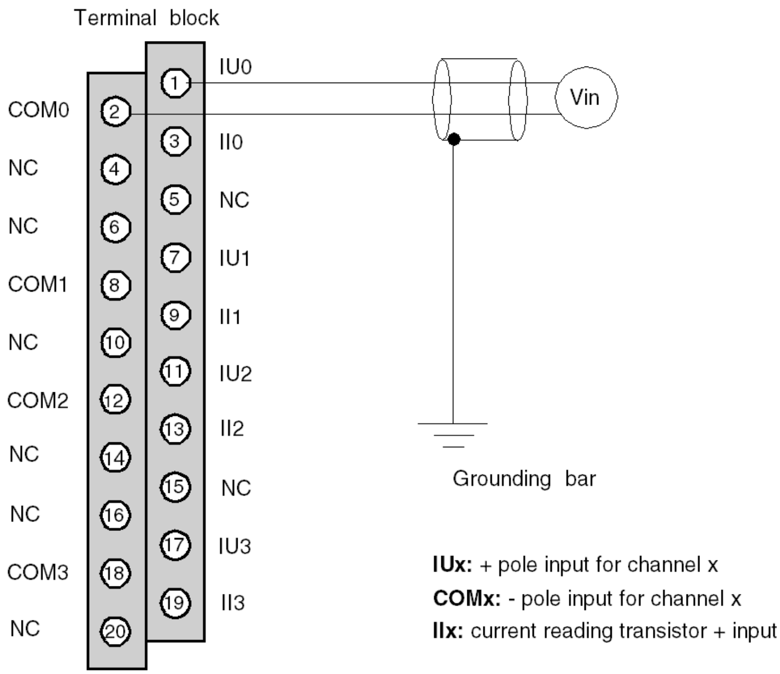
NOTE: For more information on addressing, see Unity Pro online help (click on ?, then Unity, then `Unity Pro`, then `Languages reference`, then `Data description` and `Data instances`

Input Wiring

The sensor is connected as follows.

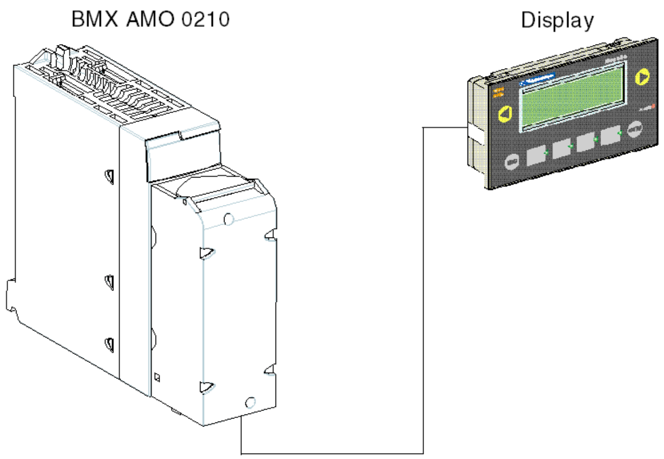


The assignment of the 20 pins terminal block is as follows.

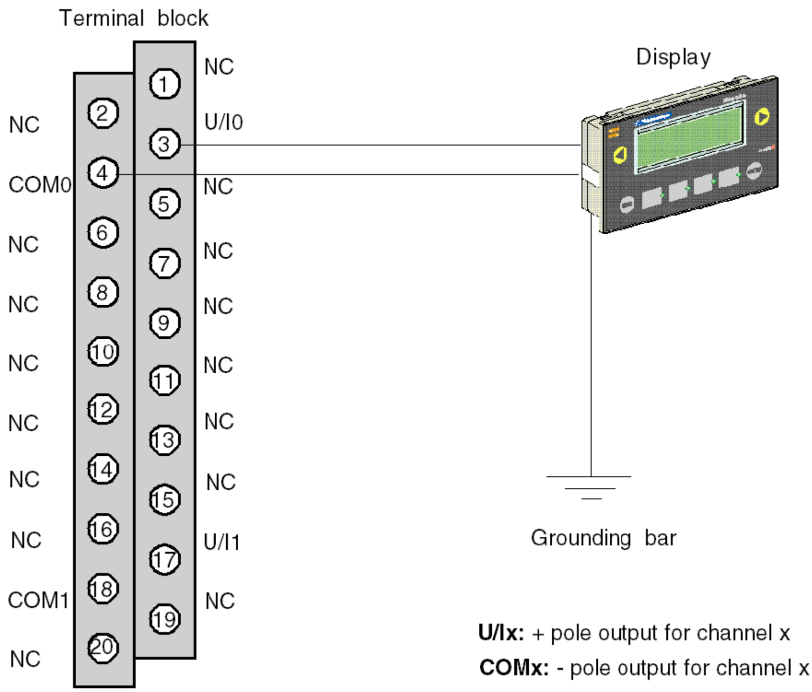


Output Wiring

The display is connected as follows.



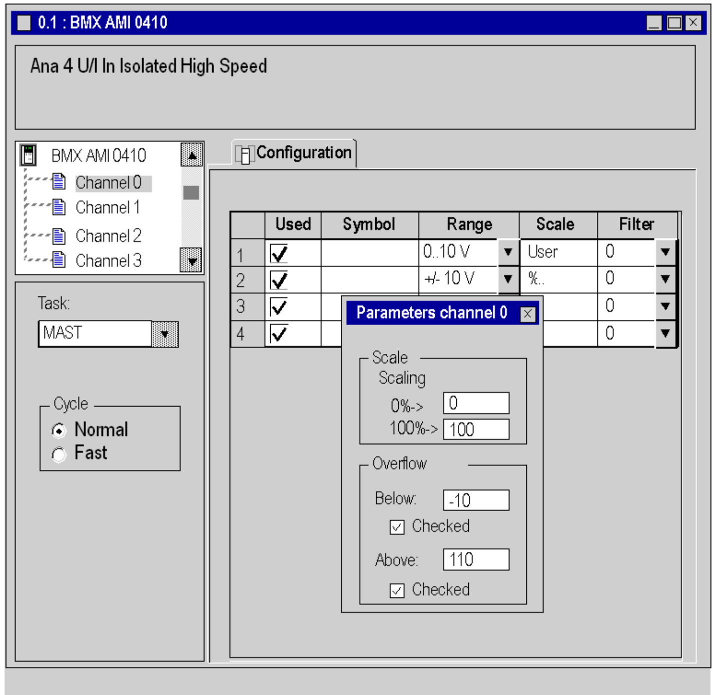
The assignment of the 20 pins terminal block is as follows.



Application Hardware Configuration

The table below shows the procedure for configuring the application.

Step	Action
1	In the `Project browser` double-click on Configuration then on `0:Bus X` and on `0:BMX XBP •••` (where 0 is the rack number).
2	In the `Bus X` window, select a slot, for example 3 and double-click on it.
3	Insert an analog input module, for example `BMX AMI 0410` The module appears on th ePLC Bus; Double-click on it..
4	In the `0.1 : BMX 0410` window, it's possible to configure the range and the scale of the used channels. For this application, configure the channel 0 to range `0..10V`

Step	Action
5	Click in the channel 0 `Scale zone`. A windows opens. Define the different values as shown in the the figure below: 

Assignment of Variables to Input Module

The table below shows the procedure for direct addressing of variables.

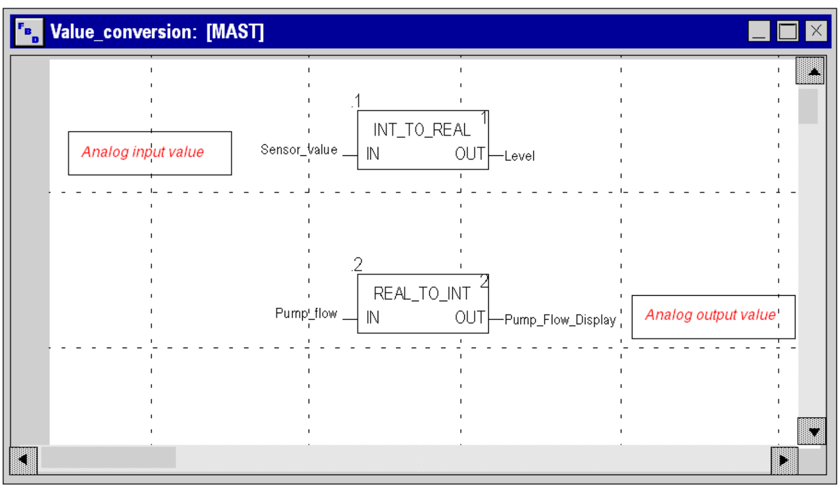
Step	Action
1	In the `Project browser` and in `Variables & FB instances`, double-click on `Elementary variables`.
2	In the `Data editor` window, select the box in the `Name` column and enter a name (`Sensor_value` for example). Select an `INT` type for this variable.
3	In the Address column, enter the analog value address associated with the variable. For this example, associate the Sensor_value variable with configured analog input channel by entering the address %IW0.1.0. Illustration: 

NOTE: Repeat the same procedure for declaring and configuring the analog output module BMX AMO 0210.

Input/Output Values Conversion

In this application, the level and the pump value are REAL type and the analog modules use integers. So Integer/Real conversions must be applied in a MAST task.

The screen below shows the I/O conversion section, written in DFB, using the Library Function BLock.



Application Execution

The table below shows the procedure for launching the application in standard mode.

Step	Action
1	In the `PLC` menu, click on `Standard Mode`,
2	In the `Build` menu, click on `Rebuild All Project`. Your project is generated and is ready to be transferred to the PLC. When you generate the project, you will see a results window. If there is an error in the program, Unity Pro indicates its location if you click on the highlighted sequence.
3	In the `PLC` menu, click on `Connection`. You are now connected to the PLC.
4	In the `PLC` menu, click on `Transfer project to PLC`. The `Transfer project to PLC` window opens. Click on `Transfer`. The application is transferred to the PLC.
5	In the `PLC`, click on `Execute`. The `Execute` window opens. Click on `OK`. The application is now being executed (in RUN mode) on the PLC.

Actions and transitions

20

Subject of this chapter

This chapter contains the actions and the transitions used in the grafcet (See *Illustration of the Tank_management Section, page 303*)

What Is in This Chapter?

This chapter contains the following topics:

Transitions

At a glance

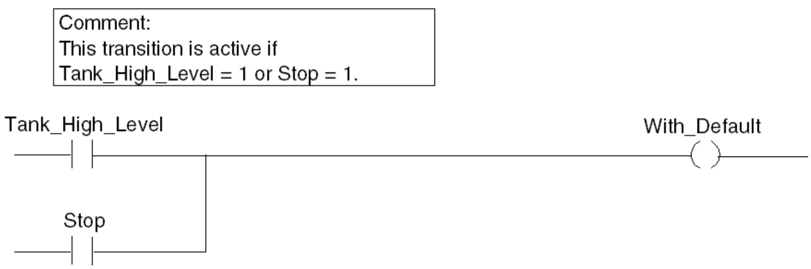
The next tasks are used in different transitions of the grafcet.

FIlling_Start transition

The action associated to the **Filling_Start** transition is as follows:

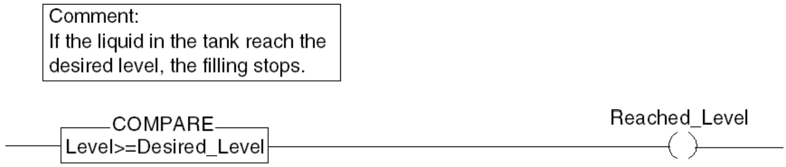
With_Default transition

The action associated to the **With_Default** transition is as follows:



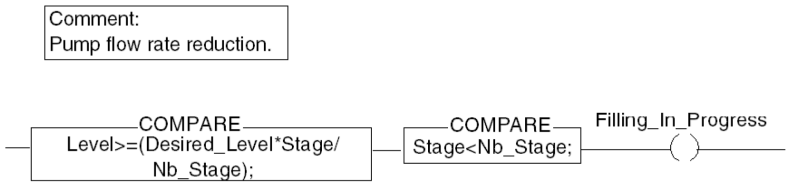
Reached_Level transition

The action associated to the **Reached_Level** transition is as follows:



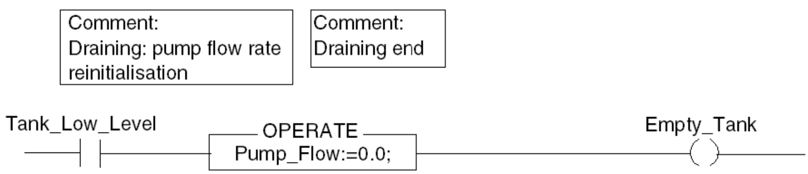
Filling_In_Progress transition

The action associated to the **Filling_In_Progress** transition is as follows:



Empty_Tank transition

The action associated to the **Empty_Tank** transition is as follows:



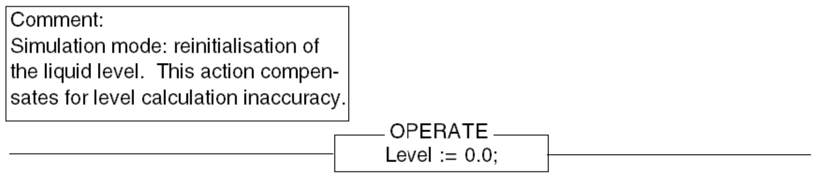
Actions

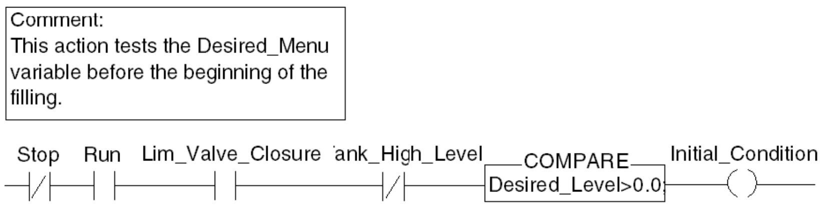
At a glance

The next tasks are used in different steps of the grafcet.

Initial step

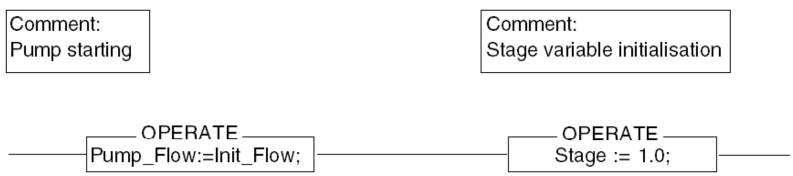
The action associated to the **Initial** step is as follows:





Init_Pump step

The action associated to the **Init_Pump** step is as follows:

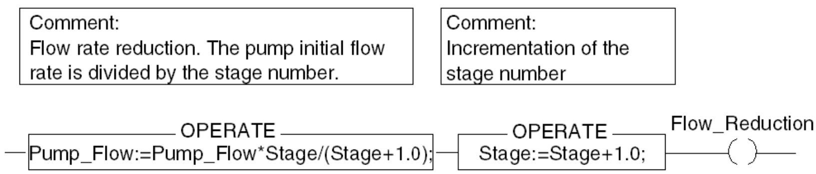


End_Alarm step

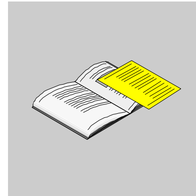
The action associated to the **End_Alarm** step is as follows:

Pump_Flow_Reduction step

The action associated to the **Pump_Flow_Reduction** step is as follows:



Appendices



Overview

These appendices contain information that should be useful for programming the application.

What Is in This Appendix?

The appendix contains the following chapters:

Characteristics of the BMX ART 0414/0814 RTD and Thermocouple Ranges

A

Subject of this Section

This section presents the characteristics of the RTD and thermocouple ranges for the BMX ART 0414/0814 analog modules.

What Is in This Chapter?

This chapter contains the following topics:

Characteristics of the RTD Ranges for the BMX ART 0414/0814 Modules

At a Glance

The table below presents the maximum margin of error, at 25° C, of the Pt100, Pt1000, and Ni1000 RTD ranges.

Temperature		Pt100 RTD	Pt1000 RTD	Ni1000 RTD
Display resolution		**0.1° C**	**0.1° C**	**0.1° C**
Maximum error at 25° C (1)				
Operating point	**-100° C**	0.8° C	1.6° C	0.4° C
	0° C	0.8° C	1.6° C	0.5° C
	100° C	0.8° C	1.6° C	0.7° C
	200° C	1.0° C	2° C	0.6° C
	300° C	1.2° C	2.4° C	
	400° C	1.3° C	2.8° C	
	500° C	1.5° C	3.3° C	
	600° C	1.7° C	3.6° C	
	700° C	1.9° C	4.1° C	
	800° C	2.1° C	4.5° C	
Input dynamic		-175..825° C -283..1,517° F	-175..825° C -283..1,517° F	-54..174° C -66..346° F
Legend:				
(1) Ambient temperature				

NOTE: The precision values are provided for a 3/4-wire connection and include the errors and drift of the 1.13 mA (Pt100) or 0.24 mA (Pt1000 or Ni1000) current source.

The effects of self-heating do not introduce any significant error to the measurement, whether the probe is in the air or under water.

The table below presents the maximum margin of error, between 0 and 60° C, of the Pt100, Pt1000, and Ni1000 RTD ranges.

Temperature		Pt100 RTD	Pt1000 RTD	Ni1000 RTD
Display resolution		**0.1° C**	**0.1° C**	**0.1° C**
Maximum error from 0 to 60° C				
Operating point	**-100° C**	1° C	2° C	0.8
	0° C	1° C	2° C	0.9° C
	100° C	1° C	2° C	1.1° C
	200° C	1.2° C	2.4° C	1.3° C
	300° C	1.5° C	3° C	
	400° C	1.8° C	3.6° C	
	500° C	2° C	4° C	
	600° C	2.3° C	4.6° C	
	700° C	2.5° C	5° C	
	800° C	2.8° C	5.6° C	
Input dynamic		-175..825° C -283..1,517° F	-175..825° C -283..1,517° F	-54..174° C -66..346° F

NOTE: The precision values are provided for 4-wire connection and include the errors and drift of the 1.13 mA (Pt100) or 0.24 mA (Pt1000 or Ni1000) current source.

The effects of self-heating do not introduce any significant error to the measurement, whether the probe is in the air or under water.

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}] / 35$$

Reference standards:

- Pt100/Pt1000 RTD : NF C 42-330 June 1983 and IEC 751, 2nd edition 1986.
- Ni1000 RTD: DIN 43760 September 1987.

Characteristics of the BMX ART 0414/814 Thermocouple Ranges in Degrees Celsius

Introduction

The following tables show the measuring device errors for the various thermocouples B, E, J, K, N, R, S and T **in degrees Celsius**.

- The precision values given below are valid irrespective of the type of cold junction compensation: TELEFAST or Pt100 class A.
- The cold junction temperature considered in the precision calculation is 25° C.
- The resolution is given with a mid-range operating point.
- The precision values include:
  - electrical errors on the acquisition system for input channels and cold junction compensation, software errors and interchangeability errors on the cold junction compensation sensors.
  - thermocouple sensor errors are not taken into account.

Thermocouples B, E, J, and K

The table below shows the maximum error values for thermocouples B, E, J, and K at 25° C.

Temperature		Thermocouple B		Thermocouple E		Thermocouple J		Thermocouple K	
Maximum error at 25° C (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-200° C**			3.7° C	2.5° C			3.7° C	2.5° C
	-100° C			2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C
	0° C			2.5° C	2.3° C	2.5° C	2.3° C	2.5° C	2.3° C
	100° C			2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C
	200° C	3.5° C	3.4° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.5° C
	300° C	3.2° C	3.0° C	2.7° C	2.5° C	2.7° C	2.5° C	2.6° C	2.4° C
	400° C	3.0° C	2.8° C	2.7° C	2.5° C	2.7° C	2.5° C	2.7° C	2.5° C
	500° C	3.0° C	2.8° C	2.8° C	2.6° C	2.8° C	2.6° C	2.8° C	2.6° C
	600° C	3.0° C	2.8° C	2.8° C	2.6° C	2.8° C	2.6° C	2.8° C	2.6° C
	700° C	3.0° C	2.8° C	2.8° C	2.6° C	2.8° C	2.6° C	2.9° C	2.7° C
	800° C	3.0° C	2.8° C	2.9° C	2.7° C			2.9° C	2.7° C
	900° C	3.0° C	2.8° C	2.9° C	2.7° C			3.0° C	2.8° C
	1,000° C	3.0° C	2.8° C					3.0° C	2.8° C
	1,100° C	3.0° C	2.8° C					3.1° C	2.9° C
	1,200° C	3.0° C	2.8° C					3.2° C	3.0° C
	1,300° C	3.0° C	2.8° C					3.3° C	3.1° C
	1,400° C	3.1° C	2.9° C						
	1,500° C	3.1° C	2.9° C						
	1,600° C	3.1° C	2.9° C						
	1,700° C	3.2° C	3.0° C						
	1,800° C	3.3° C	3.1° C						
Input dynamic		1710..17,790° C		-2,400..9,700° C		-7,770..7,370° C		-23,100..13.310° C	

Legend:

(1) TFAST: Internal compensation by TELEFAST.
PT100: External compensation by Pt100 3 wires.

Reference standards: IEC 584-1, 1st edition, 1977 and IEC 584-2, 2nd edition, 1989.

Thermocouples L, N, R, and S

The table below shows the maximum precision error values for thermocouples L, N, R, and S at 25° C.

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum error at 25° C (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-200° C**			3.7° C	2.5° C				
	-100° C			2.6° C	2.4° C				
	0° C	2.5° C	2.3° C	2.5° C	2.3° C	2.5° C	2.3° C	2.5° C	2.3° C
	100° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C
	200° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C
	300° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C	2.6° C	2.4° C
	400° C	2.7° C	2.5° C	2.7° C	2.5° C	2.7° C	2.5° C	2.7° C	2.5° C
	500° C	2.7° C	2.5° C	2.7° C	2.5° C	2.7° C	2.5° C	2.7° C	2.5° C
	600° C	2.8° C	2.6° C	2.8° C	2.6° C	2.8° C	2.6° C	2.7° C	2.5° C
	700° C	2.8° C	2.6° C	2.8° C	2.6° C	2.8° C	2.6° C	2.8° C	2.6° C
	800° C	2.9° C	2.7° C	2.9° C	2.7° C	2.8° C	2.6° C	2.8° C	2.6° C
	900° C	2.9° C	2.7° C	2.9° C	2.7° C	2.9° C	2.7° C	2.9° C	2.7° C
	1,000° C			3.0° C	2.8° C	2.9° C	2.7° C	2.9° C	2.7° C
	1,100° C			3.0° C	2.8° C	2.9° C	2.7° C	3.0° C	2.8° C
	1,200° C			3.1° C	2.9° C	3.0° C	2.8° C	3.0° C	2.8° C
	1,300° C					3.0° C	2.8° C	3.1° C	2.9° C
	1,400° C					3.1° C	2.9° C	3.1° C	2.9° C
	1,500° C					3.1° C	2.9° C	3.2° C	3.0° C
	1,600° C					3.2° C	3.0° C	3.2° C	3.0° C
	1,700° C					3.2° C	3.0° C	3.2° C	3.0° C
Input dynamic		-1,740..8,740° C		-2,320..12,620° C		-90..16,240° C		-90..16,240° C	
Legend: (1) TFAST: Internal compensation by TELEFAST. PT100: External compensation by Pt100 3 wires.									

Reference standards:

- Thermocouple L: DIN 43710, December 1985 edition.
- Thermocouple N: IEC 584-1, 2nd edition, 1989 and IEC 584-2, 2nd edition, 1989.
- Thermocouple R: IEC 584-1, 1st edition, 1977 and IEC 584-2, 2nd edition, 1989.
- Thermocouple S: IEC 584-1, 1st edition, 1977 and IEC 584-2, 2nd edition, 1989.

Thermocouples T and U

The table below shows the maximum precision error values for thermocouples T and U at 25° C.

Temperature		Thermocouple T		Thermocouple U	
Maximum error at 25° C (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-200° C**	3.7° C	2.5° C		
	-100° C	3.6° C	2.4° C		
	0° C	3.5° C	2.3° C	2.5° C	2.3° C
	100° C	2.6° C	2.4° C	2.6° C	2.4° C
	200° C	2.6° C	2.4° C	2.6° C	2.4° C
	300° C	2.6° C	2.4° C	2.6° C	2.4° C
	400° C	2.7° C	2.5° C	2.7° C	2.5° C
	500° C			2.7° C	2.5° C
	600° C			2.7° C	2.5° C
Input dynamic		-2,540..3,840° C		-1,810..5,810° C	
Legend: (1) TFAST: Internal compensation by TELEFAST. PT100: External compensation by Pt100 3 wires.					

Reference standards:

- Thermocouple U: DIN 43710, December 1985 edition.
- Thermocouple T: IEC 584-1, 1st edition, 1977 and IEC 584-2, 2nd edition, 1989.

Characteristics of the BMX ART 0414/814 Thermocouple Ranges in Degrees Fahrenheit

Introduction

The following tables show the errors of the measuring device for the various thermocouples B, E, J, K, N, R, S and T **in degrees Fahrenheit**.

- The precision values given below are valid for all of the type of cold junction compensation: TELEFAST or Pt100 class A.
- The cold junction temperature considered in the precision calculation is 77° F.
- The resolution is given with a mid-range operating point.
- The precision values include:
  - electrical errors on the acquisition system for input channels and cold junction compensation, software errors and interchangeability errors on the cold junction compensation sensors.
  - thermocouple sensor errors are not taken into account.

Thermocouples B, E, J and K

The table below shows the maximum precision error values for thermocouples B, E, J and K at 77° F:

Temperature		Thermocouple B		Thermocouple E		Thermocouple J		Thermocouple K	
Maximum error at 77° F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300° F**			6.7° F	4.5° F			6.7° F	4.5° F
	-100° F			4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	0° F			4.5° F	4.1° F	4.5° F	4.1° F	4.5° F	4.1° F
	200° F			4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	400° F	6.3° F	6.1° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	600° F	5.8° F	5.4° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F
	700° F	5.4° F	5.0° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F
	900° F	5.4° F	5.0° F	5.0° F	4.7° F	5.0° F	4.7° F	5.0° F	4.7° F
	1,100° F	5.4° F	5.0° F	5.0° F	4.7° F	5.0° F	4.7° F	5.0° F	4.7° F
	1,300° F	5.4° F	5.0° F	5.0° F	4.7° F	5.0° F	4.7° F	5.2° F	4.9° F
	1,500° F	5.4° F	5.0° F	5.2° F	4.9° F			5.2° F	4.9° F
	1,700° F	5.4° F	5.0° F	5.2° F	4.9° F			5.4° F	5.0° F
	1,800° F	5.4° F	5.0° F					5.4° F	5.0° F
	2,000° F	5.4° F	5.0° F					5.4° F	5.0° F
	2,200° F	5.4° F	5.0° F					5.4° F	5.0° F
	2,400° F	5.4° F	5.0° F					5.4° F	5.0° F
	2,600° F	5.6° F	5.2° C						
	2,700° F	5.6° F	5.2° C						
	2,900° F	5.6° F	5.2° C						
	3,100° F	5.8° F	5.4° F						
	3,200° F	6.0° F	5.6° F						
Input dynamic		3,390..32,000° F		-3,990..17,770° F		-2,870..13,950° F		-3,830..24,270° F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.
PT100: External compensation by Pt100 3 wires.

Thermocouples L, N, R and S

The table below shows the maximum precision error values for thermocouples L, N, R and S at 77° F:

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum error at 77° F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300° F**			6.7° F	4.5° F				
	-100° F			4.7° F	4.3° F				
	0° F	4.5° F	4.1° F	4.5° F	4.1° F	4.5° F	4.1° F	4.5° F	4.1° F
	200° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	400° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	600° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F	4.7° F	4.3° F
	700° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F
	900° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F	4.9° F	4.5° F
	1,100° F	5.0° F	4.7° F	5.0° F	4.7° F	5.0° F	4.7° F	4.9° F	4.5° F
	1,300° F	5.0° F	4.7° F	5.0° F	4.7° F	5.0° F	4.7° F	5.0° F	4.7° F
	1,500° F	5.2° F	4.9° F	5.2° F	4.9° F	5.2° F	4.9° F	5.2° F	4.9° F
	1,700° F	5.2° F	4.9° F	5.2° F	4.9° F	5.2° F	4.9° F	5.2° F	4.9° F
	1,800° F					5.2° F	4.9° F	5.2° F	4.9° F
	2,000° F					5.2° F	4.9° F	5.4° F	5.0° F
	2,200° F					5.4° F	5.0° F	5.4° F	5.0° F
	2,400° F					5.4° F	5.0° F	5.6° F	5.2° F
	2,600° F					5.6° F	5.2° F	5.6° F	5.2° F
	2,700° F					5.6° F	5.2° F	5.8° F	5.4° F
	2,900° F					5.8° F	5.4° F	5.8° F	5.4° F
	3,000° F					5.8° F	5.4° F	5.8° F	5.4° F
Input dynamic (2)		-2,800..16,040° F		-3,860..23,040° F		-160..29,950° F		-160..29,950° F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.
PT100: External compensation by Pt100 3 wires.

(2) Internal compensation: ambient temperature = 68° F.
External compensation: ambient temperature = 86° F.

Thermocouples T and U

The table below shows the maximum precision error values for thermocouples T and U at 77° F:

Temperature		Thermocouple T		Thermocouple U	
Maximum error at 77° F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300° F**	6.7° F	4.5° F		
	-100° F	6.5° F	4.3° F		
	0° F	6.3° F	4.1° F	4.5° F	4.1° F
	200° F	4.7° F	4.3° F	4.7° F	4.3° F
	400° F	4.7° F	4.3° F	4.7° F	4.3° F
	600° F	4.7° F	4.3° F	4.7° F	4.3° F
	700° F	4.9° F	4.5° F	4.9° F	4.5° F
	900° F			4.9° F	4.5° F
	1,100° F			4.9° F	4.5° F
Input dynamic (2)		-4,250..7,230° F		-2,930..10,770° F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.
PT100: External compensation by Pt100 3 wires.

Topological/State RAM Addressing of the Modules

B

Topological/State RAM Addressing of Modicon M340 Analog Modules

Analog Modules

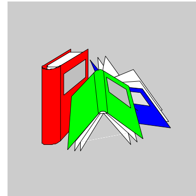
With Unity Pro 6.1 or later and Modicon M340 firmware 2.4 or later, you can access the modules either via topological or State RAM addresses. Please also refer to *Memory Tab (see Unity Pro, Operating Modes)*.

The following table shows the Modicon M340 analog module objects that can be mapped to topological or State RAM addresses.

Module reference	Topological address	State RAM address
BMX AMI 0410	%IW rack.slot.channel, channel [0,3]	-%IWStart address ... %IWStart address + 3
BMX AMI 0800	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7
BMX AMI 0810	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7
BMX AMM 0600	%IW rack.slot.channel, channel [0,3] %QW rack.slot.channel, channel [4,5]	-%IWStart address ... %IWStart address + 3 and -%MWStart address ... %MWStart address + 1
BMX AMO 0210	%QW rack.slot.channel, channel [0,1]	-%MWStart address ... %MWStart address +1
BMX AMO 0410	%QW rack.slot.channel, channel [0,3]	-%MWStart address ... %MWStart address + 3
BMX AMO 0802	%QW rack.slot.channel, channel [0,7]	-%MWStart address ... %MWStart address + 7
BMX ART 0414	%IW rack.slot.channel, channel [0,3]	-Value: -%IWStart address ... %IWStart address + 3 -Cold junction: -%IWStart address + 4
BMX ART 0814	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7 -Cold junction, ch 0-3: %IWStart address + 8 -Cold junction, ch 4-7: %IWStart address + 9

For additional information please refer to *Special Conversion for Compact I/O Modules (see LL984 Editor, Reference Manual, LL984 Specifics)*.

Glossary



0-9

%I

According to the IEC standard, `%I` indicates a discrete input-type language object.

%M

According to the IEC standard, `%M` indicates a memory bit-type language object.

%MW

According to the IEC standard, `%MW` indicates a memory word-type language object.

%Q

According to the IEC standard, `%Q` indicates a discrete output-type language object.

B

BIT

This is a binary unit for a quantity of information which can represent two distinct values (or statuses): 0 or 1.

BOOL

`BOOL` is the abbreviation of Boolean type. This is the elementary data item in computing. A `BOOL` type variable has a value of either: 0 (`FALSE`) or 1 (`TRUE`).

A `BOOL` type word extract bit, for example: `%MW10.4`.

BYTE

When 8 bits are put together, this is called a BYTE. A BYTE is either entered in binary, or in base 8.

The BYTE type is coded in an 8 bit format, which, in hexadecimal, ranges from 16#00 to 16#FF

D

DFB

DFB is the abbreviation of Derived Function Block.

DFB types are function blocks that can be programmed by the user ST, IL, LD or FBD.

By using DFB types in an application, it is possible to:

- simplify the design and input of the program,
- increase the legibility of the program,
- facilitate the debugging of the program,
- reduce the volume of the generated code.

DFB instance

A DFB type instance occurs when an instance is called from a language editor.

The instance possesses a name, input/output interfaces, the public and private variables are duplicated (one duplication per instance, the code is not duplicated).

A DFB type can have several instances.

E

EBOOL

EBOOL is the abbreviation of Extended Boolean type. It can be used to manage rising or falling edges, as well as forcing.

An EBOOL type variable takes up one byte of memory.

EFB

Is the abbreviation for Elementary Function Block.

This is a block which is used in a program, and which performs a predefined software function.

EFBs have internal statuses and parameters. Even where the inputs are identical, the output values may be different. For example, a counter has an output which indicates that the preselection value has been reached. This output is set to 1 when the current value is equal to the preselection value.

F

FBD

FBD is the abbreviation of Function Block Diagram.

FBD is a graphic programming language that operates as a logic diagram. In addition to the simple logic blocks (AND, OR, etc.), each function or function block of the program is represented using this graphic form. For each block, the inputs are located to the left and the outputs to the right. The outputs of the blocks can be linked to the inputs of other blocks to form complex expressions.

Function view

View making it possible to see the program part of the application through the functional modules created by the user (see Functional module definition).

I

IEC 61131-3

International standard: Programmable Logic Controls

Part 3: Programming languages.

IL

IL is the abbreviation of Instruction List.

This language is a series of basic instructions.

This language is very close to the assembly language used to program processors.

Each instruction is composed of an instruction code and an operand.

Instantiate

To instantiate an object is to allocate a memory space whose size depends on the type of object to be instantiated. When an object is instantiated, it exists and can be manipulated by the program.

INT

`INT` is the abbreviation of single integer format (coded on 16 bits).

The lower and upper limits are as follows: -(2 to the power of 31) to (2 to the power of 31) - 1.

Example:

`-32768`, `32767`, `2#1111110001001001`, `16#9FA4`.

L

LD

LD is the abbreviation of Ladder Diagram.

LD is a programming language, representing the instructions to be carried out in the form of graphic diagrams very close to a schematic electrical diagram (contacts, coils, etc.).

Located variable

A located variable is a variable for which it is possible to know its position in the PLC memory. For example, the variable `Water_pressure`, is associated with `%MW102`. `Water_pressure` is said to be located.

M

Master task

Main program task.

It is obligatory and is used to carry out sequential processing of the PLC.

O

Operator screen

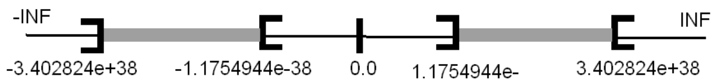
This is an editor that is integrated into Unity Pro, which is used to facilitate the operation of an automated process. The user regulates and monitors the operation of the installation, and, in the case of any unexpected event, can act quickly and simply.

R

REAL

Real type is a coded type in 32 bits.

The ranges of possible values are illustrated in gray in the following diagram:



When a calculation result is:

- between -1.175494e-38 and 1.175494e-38 it is considered as a `DEN`,
- less than -3.402824e+38, the symbol `-INF` (for -infinite) is displayed,
- greater than +3.402824e+38, the symbol `INF` (for +infinite) is displayed,
- undefined (square root of a negative number), the symbol `NAN` is displayed.

S

Section

Program module belonging to a task which can be written in the language chosen by the programmer (FBD, LD, ST, IL, or SFC).

A task can be composed of several sections, the order of execution of the sections corresponding to the order in which they are created. This order is modifiable.

SFC

SFC is the abbreviation of Sequential Function Chart.

SFC enables the operation of a sequential automation device to be represented graphically and in a structured manner. This graphic description of the sequential behavior of an automation device, and the various situations which result from it, is provided using simple graphic symbols.

SFC objects

An SFC object is a data structure representing the status properties of an action or transition of a sequential chart.

ST

ST is the abbreviation of Structured Text language.

Structured Text language is an elaborated language close to computer programming languages. It enables you to structure series of instructions.

Structure

View in the project navigator with represents the project structure.

Subroutine

Program module belonging to a task (MAST, FAST) which can be written in the language chosen by the programmer (FBD, LD, ST, or IL).

A subroutine may only be called by a section or by another subroutine belonging to the task in which it is declared.

T

Task

A group of sections and subroutines, executed cyclically or periodically for the MAST task, or periodically for the FAST task.

A task possesses a level of priority and is linked to inputs and outputs of the PLC. These I/O are refreshed in consequence.

TIME

The type `TIME` expresses a duration in milliseconds. Coded in 32 bits, this type makes it possible to obtain periods from 0 to (2 to the power of 32)-1 milliseconds.

U

Unlocated variable

An unlocated variable is a variable for which it is impossible to know its position in the PLC memory. A variable which have no address assigned is said to be unlocated.

V

Variable

Memory entity of the type `BOOL`, `WORD`, `DWORD`, etc., whose contents can be modified by the program during execution.

W

WORD

The `WORD` type is coded in 16 bit format and is used to carry out processing on bit strings.

This table shows the lower/upper limits of the bases which can be used:

Base	Lower limit	Upper limit
Hexadecimal	16#0	16#FFFF
Octal	8#0	8#177777
Binary	2#0	2#1111111111111111

Representation examples

Data content	Representation in one of the bases
0000000011010011	16#D3
1010101010101010	8#125252
0000000011010011	2#11010011

Index